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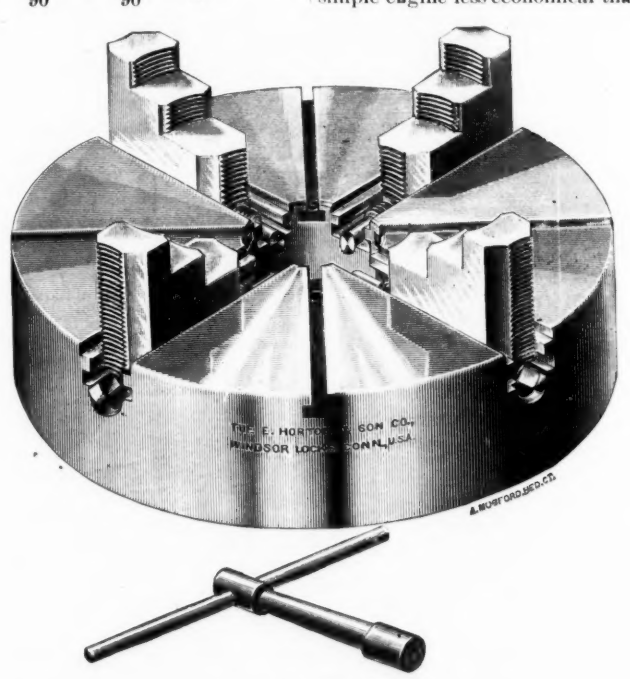
Reversible Jaw Chuck.

The accompanying cut illustrates a new 30″ four jaw independent, reversible chuck, made by The E. Horton & Son Company, Windsor Locks, Conn. It is designed to meet the requirements of those who want a strong, durable and convenient independent chuck.

The main difference between this and their ordinary improved independent chuck, is the T slots in the face, which are accurately milled their whole length, and are convenient to aid in holding long work steady in the chuck, by means of bolts, the heads of which slide in the slots. Another advantage of this chuck is, that by simply removing the jaws, the body answers every purpose of a lathe face plate, and much time will be saved, in shifting from the lathe the chuck, when it becomes necessary to use a face plate, and *vice versa*.

The name of the makers is of course a sufficient guarantee of the quality of its workmanship.



HORTON LATHE CHUCK.

Compound Engines.

BY W. H. BOOTH.

SEVENTH PAPER.

CYLINDER PROPORTIONS.

We have drawn attention to the effect of cut-off in modifying the action and the ratio of work performed in the two cylinders. From what we have already said it will be reasoned, no doubt, that the ratio of the cylinder columns is not a matter of very serious importance. Nor, indeed, is the ratio of special moment within certain limits, so long as the means of controlling the influence of cylinder ratios are to hand and understood. In designing any engine, the first point to determine is the terminal pressure. From this, if we know our initial pressure, the grade of expansion may be found. The writer has usually assumed the terminal pressure in a compound engine to be about 9 pounds absolute. Hence, with steam of 80 pounds gauge pressure the initial absolute pressure would be about 95, and the ratio of expansion 10½ about. One rule for cylinder ratios is to extract the square root of the expansion ratio, and proportion cylinders to this ratio. Thus the square root of 10½ is 3⅛ nearly, and we should make one cylinder three times the capacity of the other in practice, always adding slightly to the small cylinder. Other engineers will adopt half an atmosphere as a suitable terminal pressure. A common rule for cylinder ratios is

$$r = \frac{P\,n}{10\,t}$$

where r is the ratio sought, P is the absolute initial pressure in the first cylinder, and t is the terminal in the large cylinder, n is the number of 10ths of the stroke of the small piston during which admission takes place. Expressed in form of a rule, this formula may be written as follows:

Multiply the absolute pressure in the small cylinder by the number of tenths of the stroke during which admission takes place. Divide the product by ten times the terminal pressure. The result is the ratio of the cylinders.

This rule determines, of course, the capacity ratio of the cylinders. The capacity being the area multiplied by length of stroke. When the stroke is the same, the rule, of course, determines their area ratio. Frequently, however, the strokes of the two pistons are unequal. In such case the rule may be used to find the area ratio as if the strokes were equal, after which the true high pressure area may be found by increasing or decreasing the area found by such proportion as the true stroke is less or more than that assumed; the process of course being an inverse proportion, and the cylinder area requiring to be doubled, for example, if the stroke has been assumed at twice what it really is to be.

With P as before $= 95$ pounds and $t = 9$ pounds, we have for $n = 3$

$$r = \frac{95 \times 3}{90} = \frac{285}{90} = 3\tfrac{1}{6}.$$

Or when R is the ratio of expansion, we have

$$r = \frac{R\,n}{10}.$$

Now we have $R = 10.5$, hence with $n = 3$, we have

$$r = \frac{10.5 \times 3}{10} = 3.15.$$

The size of the first cylinder is therefore governed by the period of admission that may be chosen for it.

I have already shown the disadvantage of the so-called Woolf system of working, whereby the high pressure cylinder takes steam throughout its whole stroke. In such an arrangement there is no expansion in the first cylinder, and theoretically the initial pressure in the large cylinder is that of the boiler, so that the advantages of compounding are lost entirely, so far as regards all those conditions depending upon the heat trap theory, so-called, and on radiation and temperature range. In practice, however, the Woolf engine cannot well be worked without a very excessive drop in the pressure existing between the two cylinders in the pipes or receivers, so that in either method working the Woolf type of engine, the advantages of compounding are largely lost. Hence it is that we say that the first cylinder should be at least of such capacity as to allow of considerable expansion, and the above rules have been chosen, as they give such a ratio as is in practice found to give good results. Within reasonable limits either way any departure from the ratio as thus found will not be productive of any serious loss; for within such limits it is always easy to regulate the proportion of work done by the two cylinders by an alteration in the low pressure cut-off.

When the high pressure cylinder is large the stresses in the working parts of the engine are large also, and there is considerable difference between the initial and the mean pressures, and this consideration will have its effect with the designer as well as the greater radiating surfaces of a large cylinder, and in fact all those causes which combine to render the simple engine less economical than the compound are found the more largely as the first cylinder is increased, until finally the second cylinder would become useless, though being no larger than the first. For let it be imagined that steam of 60 pounds absolute pressure be admitted for half stroke into a cylinder of a capacity of 1. At the half stroke cut-off takes place, and at the end of the stroke the pressure must be 30 pounds. Exhaust then takes place into the second cylinder, also of the capacity 1, or the same as the first cylinder. Then as the second piston advances, so does the first piston follow it inch for inch, and between the two pistons there is always one constant capacity volume. Hence the terminal pressure of 30 pounds in the first cylinder is the initial pressure in the second cylinder, and also the pressure throughout the stroke, and the forward pressure on one piston is simply the back pressure on another piston of the same area, and the result is a balance.

When the second cylinder is actually smaller than the first, it does not appear that any motion could take place, as the steam would choke back upon the first piston and stop the machine. Hence cylinders of equal capacity are of the extreme possible limiting ratio in the theoretical compound engine, and it would serve no good purpose to study how the effects of cylinder radiation and condensation in an actual engine would enable even this ratio to be slightly exceeded.

At the other extreme the limiting ratio of cylinders appears rationally to be reached at that point where it becomes necessary to carry steam admission absolutely throughout the stroke of the small cylinder, in order to keep the engine up to speed. This, of course, is the maximum limit of the Woolf system. In event of an engine so worked, and yet unable to keep speed, it would be possible to increase its power of doing work by using a valve to the first cylinder, having negative steam lap, that is, one providing that at times both sides of the piston were in direct communication with the boiler. This, with co-existing exhaust opening, would simply allow a portion of boiler steam to pass directly to the second cylinder, using the high pressure valve chest as a passageway merely. Such a course would necessarily imply that the first cylinder should be removed or replaced by one of greater capacity. The rule we have given fixes cylinder ratios, from which much departure is not, therefore, advisable, unless circumstances compel.

Already there is speculation as to the crop prospects, and from now till the end of the season, the probable yield of the staple agricultural products of the country will form a common topic for discussion. And upon these prospects the general business outlook will be largely, and very correctly judged. Newspaper proprietors will go to a great deal of expense to collect data as to the condition of the growing crops all the way from Maine to California, because experience shows that every reader is interested in the subject, although he may know absolutely nothing about the work of the farmer. The mechanic and the merchant are as deeply interested in the matter as the farmer himself.

The expression so far is that crops will be fairly good. And this means a fair amount of work for the railroads, with such a distribution of money to bring about exchange of commodities, as leads to good times if left to work without too much artificial restraint.

Let us all hope that the predictions of good crops will be verified. When the farmer has money, the manufacturer finds sales for his wares; we are all obliged to fall back on the products of the soil.

The New England Foundry Foremen's Association hold their annual meeting in Worcester, Mass., July 10th. All foundry men are invited to send to the secretary, not later than July 1st, subjects of importance to the trade for discussion.

A cordial invitation is extended to all proprietors and foremen of foundries to be present at the meeting.

Communications should be addressed to J. P. Pero, Secretary, care Munn & Anstice, Rochester, N. Y.

General Sherman thinks if there is ever again a war in this country the greatest army will be made up of railroad men. Well, there is enough of them for an army about one million strong, and they are good material; but how about operating the railroads while they are doing the fighting? Military operations at the present time call for a good deal of railroading.

Modern Locomotive Construction.

BY J. G. A. MEYER.

SIXTY-EIGHTH PAPER.

Distribution of Flanged Tires in the Various Classes of Locomotives.

In a large majority of eight-wheeled passenger engines, in which four of the whole number of wheels are driving wheels, as shown in Fig. 1, all the driving wheels have flanged tires. We have noticed only a very few of this class of engines, in which one pair of drivers—the front ones—had plain tires, leaving only one pair of driving wheels,—the rear ones—to guide the engine over a curve. This we believe to be dangerous practice. All wheels in this class of engines should have flanges.

In a great number of mogul engines, in which six wheels of the whole number are driving wheels, as shown in Fig. 2, the front and rear driving wheels have flanged tires; the middle pair have plain tires. We believe this to be the best practice, for the following reasons: All locomotives have a tendency to sway in front, from side to side; this is objectionable. Now, a mogul engine has only a two-wheeled truck (generally called a pony truck) in front, and such a truck, without the aid of the flanges on the first pair of drivers, is not suitable to guide the engine steadily on a straight track, neither is it suitable to guide it safely over a curve. In short, more than two wheels with flanges (particularly when these wheels are truck wheels) are needed to guide the engine steadily in front.

In ten-wheeled engines, in which six wheels of the whole number are driving wheels, as shown in Fig. 3, the rear pair of drivers, and the pair next to it, have flanged tires. In these engines the four-wheeled truck in front is generally considered to be sufficient to guide the engine steadily on a straight track, and safely over a curve, without the aid of flanges on the front driving wheels.

In consolidation engines, in which eight wheels of the whole number are driving wheels, as shown in Fig. 4, the distribution of flanged tires somewhat differs on the various railroads. All these engines have in front a two-wheeled, that is, a pony truck, and since, as we have stated before, a two-wheeled truck is generally considered insufficient to guide an engine steadily on a straight track, or safely over a curve, we find that nearly every engine of this class has flanged tires on their front drivers. As to the other driving-wheels under the same engines, we often find the rear pair, and the pair next to it, with flanged tires, leaving only one pair of driving wheels (the pair next to the front ones) with plain tires.

This arrangement seems to indicate that some designers consider two pairs of the whole number of wheels, including truck wheels, to be necessary for the purpose of guiding the rear end of the locomotive; and two pairs of wheels, to guide the front end of the engines.

But this arrangement is by no means a universal one, as we frequently meet with consolidation engines, in which only the rear and front pairs of driving wheels have flanged tires, leaving the two intermediate pairs of driving wheels with plain tires. This arrangement seems to indicate that if one pair of wheels with flanges is sufficient to guide, as is generally the case, the rear end of a mogul engine, one pair of wheels with flanges will also be sufficient to guide the rear end of a consolidation engine, and that plain tires on the two intermediate driving wheels will allow the engine to curve easier. In a few instances we find the flanged tires distributed so as to bring the flanges on alternate driving wheels. In such cases the rear and third pair of driving wheels, counting from the rear end, will have flanged tires, the second pair from the rear, and the front pair, will have plain tires. Our favorite arrangement is to have flanges on the front and rear driving wheels; these, we believe, will guide the engine steadily, and allow it to curve easily.

Lastly, occasionally we meet with consolidation, mogul, and ten-wheeled engines, under which all the driving wheels have flanged tires.

Depth of Flanges.—The depth *D E* of the flanges of tires (Fig. 408) vary, according to the judgment of the designer, from 1 to 1¼ inch; and in a few instances the flanges are made 1½ inches deep, as shown in Fig. 405. Many master mechanics claim that flanges 1 inch deep are perfectly safe, and to prove their assertion point to engines with flanges 1 inch deep on the drivers, which are and have been running daily without any trouble or accidents; yet others claim that flanges 1¼ inch deep are safer, and adopt this depth for all their driving wheel flanges. In a large majority of locomotives the driving wheel flanges are 1⅛ inch deep—an arithmetical mean of 1 and 1¼.

Forms of Tread on Driving Wheels.—At present various forms of tread on driving wheels are used. Fig. 408 represents a section of a tire in which the tread *a b* is a surface of uniform taper. This taper varies on the different roads from ⅛ to ¾ of an inch in 12 inches. This form of tread is usually called the cone tread.

Fig. 409 represents a section of a tire in which the tread is composed of two surfaces; one surface is represented by the line *c d*, and is turned to a uniform diameter; the other surface is represented by line *d e*, and is turned to a uniform taper; in some cases this taper is as much as ¼ of an inch in 1¼ inch. This form of tread is often called the straight tread.

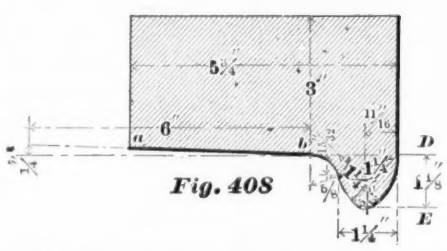


Fig. 408

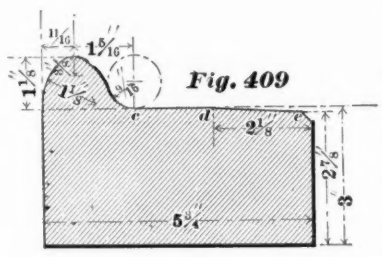


Fig. 409

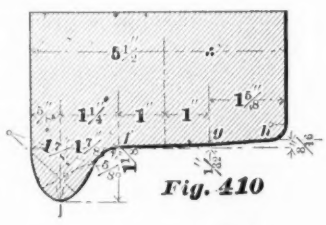


Fig. 410

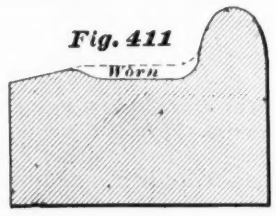


Fig. 411

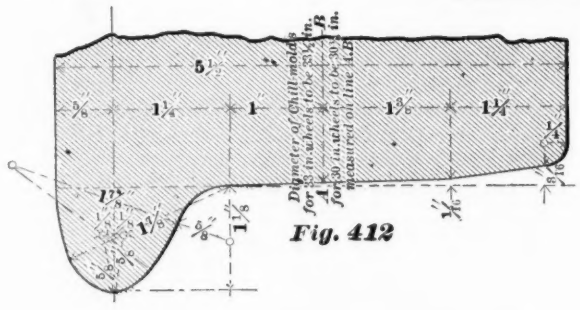


Fig. 412

Best Form of Tread.—The question now arises: Which is the best form of tread for locomotive tires? We have already seen that all locomotives have a tendency to sway from side to side at the front end, and such a sinuous motion is objectionable. Tires with a cone tread, as shown in Fig. 408, will certainly reduce to some extent this objectionable sinuous motion. We may, therefore, claim for the cone tread, particularly in engines which have only a pony truck to guide the front end, and where some dependence must be placed on the front drivers to guide, in some measure, the engine steadily, that the cone tread will help to keep the engine in the center of the track, and to some extent reduce the wear on the flanges. True, the taper of the tread near the base of the flange will soon wear off, and a channel or groove in the tire will be formed, as shown in Fig. 411. In this case the form of the ridge near the flange will, to some extent, answer the same purpose as that for which the cone tread was originally designed. Hence we may say that the cone tread is particularly desirable for engines in which the tires are new, or have not been worn. Indeed, this fact has often been proven by experience on roads, and more distinctly so on roads with sharp curves, where straight treads had to be abandoned, and replaced by cone treads, so as to obtain more satisfactory results, cause the engine to run with greater safety over the curves, and reduce the wear of the flanges when new. On the other hand, the claim that a cone tread will cause the engine to run over a curve with less friction, and less wear on the tires, than with treads of other forms, is a fallacy. For instance, the argument that the centrifugal force will cause the engine to run towards the outer rails of a curve, and thus cause the outer driving wheels to work on their large diameter, and the inner driving wheels to work on their small diameter, thereby creating a rolling motion similar to that of a cone on a flat surface, cannot be sustained when sound principles are applied.

It is true that, when a single cone is rolled over a flat surface, it will run in a curve whose radius is dependent on the taper of the cone; again, the force required to roll the cone over the flat surface needs to be only a very little greater than the resistance offered by the ordinary rolling friction of the cone. But if we now take two equal cones and fix their axes rigidly and parallel to each other in a frame, so as to obtain conditions similar to those of parallel axles and wheels under an engine, and then roll the cones over a flat surface, the results thus obtained will greatly differ from the results noticed in rolling one of the cones separately. The two cones thus held together will roll in a curve which approaches a straight line; considerable sliding friction will also be created, so that the forces required for rolling both cones held together will be considerably greater than the sum of the two forces required for rolling each cone separately.

The claim that the centrifugal force will cause the engine to run towards the outer rails of the curved track, is also very doubtful, because, to obtain such a result, the radius of the curve would have to be suitable for the speed of the engine, or the engine would have to be run at speed suitable for the radius of the curve, and these are conditions which cannot be obtained in practice. Hence we conclude that the cone tread will not lessen the wear or friction on the tread of the tires in running over a curve, but will generally prevent, to some extent, the sinuous motion of the locomotive, and somewhat lessen the wear of the flanges.

The tread shown in Fig. 410, and treads similar to it, have of late greatly grown in favor, and we believe these to be the best to adopt, as they possess not only the advantage of the cone tread, but, furthermore, possess the advantage of wearing to a better form than the cone tread; because the increased taper of the tread near the edge of the tire will reduce the outer ridge of the groove or channel, shown in Fig. 411, which is always an objectionable feature.

The straight tread shown in Fig. 409 possesses only the advantage of wearing to a better form, as stated in connection with Fig. 410, and does not possess the advantage of steadily guiding the engine when the tires are new

In the proceedings twentieth annual convention, 1887, of the American Railway Master Mechanics' Association, we see it reported that the form of the tread, such as shown in Fig. 412, has been adopted as a standard, which is the same form of tread as that adopted by the Master Car Builders' Association, and has been illustrated in the report of their twenty-first annual convention, from which our illustration has been taken. Figs. 409, 410 and 411 have been taken from the report of the proceedings of the seventeenth annual convention of the American Railway Master Mechanics' Association.

When a reporter for the daily press tackles a problem in mechanical description, he is sure to produce something striking, if not entirely lucid. For example, a reporter for the *Manchester* (*N. H.*) *Mirror* has run against a couple of locomotives—harmless enough in their proportions—lately built for a Western railroad, and he found them as "high as houses" and "longer than a large passenger coach," and he found that "one man and a half," whatever that may mean, "could stand upright in their boilers, for they measure ten feet in diameter and thirty-four feet in circumference." That reporter has succeeded in making an item that will be copied from Maine to California, which is probably materially more than he would have done had he been equipped with any conception of the subject about which he was writing.

A friend sends us a clipping from the *Industrial World*, in which our item regarding the discovery of the auger by a man who saw some boys boring in the ground with an iron barrel hoop, in England, in 1680, is reprinted and commented upon thusly:

We do not know the exact shape the boys bent that barrel hoop into, but if they were Yankee boys, and they found that by turning the "corkscrew" the wrong way, the earth was driven into the hole, the probabilities are that the boys would have sense enough to have turned the screw the other way, and thus raised the dirt out of the hole.

Yes, probably they would; but history mentions no instance of any Yankee boys being in England in 1680, and, in fact, we have an impression that the Yankee boy had not yet been invented at that time, therefore we are forced to conclude that they must have been some other kind of boys.

"Say, I'm going to move to-day, and I'd like to have you send a man and change my telephone to the new place right away," said a corpulent man who had wearily climbed two pair of stairs in Exchange Place and poked his head into the central telephone office. "All right," said Superintendent Cowdery, "it shall be done at once. (The door is being closed.) But why didn't you ask us by telephone?" "By thunder! I never thought of it," said he, and as the corpulent man descended the stairs it sounded as though he kicked himself at each alternate step.—*The Saratogian*.

The average lawyer in Philadelphia is said to enjoy an income of $1,000 a year. This is considered small pay, but as it is considerably more than the average machinist or the average blacksmith can contrive to earn or get, it does not seem necessary to waste any sympathy on lawyers as a class. Columbia College recently turned out one hundred and forty-six lawyers, so, on the whole, the pay seems to be considered satisfactory.

Practical Details of Blacksmithing.

BY B. F. SPALDING.

SHEET STEEL WORK—SEEDER SHANKS—SHOE HOES—SHAPE OF PUNCH PRESS—STRENGTH IN FORM—TRANSFERRING PUNCHED HOLES—WELDING FUEL—FLUX—HORIZONTAL BENDER—SAND ABRASION.

The stock compassing the throat of a punch press is made wide across, because if it was thin it would crack. The wider it is, the less chance there is for a crack to start. It is also rounded; there are no places where the stock comes to a weak edge, but behind the broad web of the throat the stock is abruptly thinned, and extends in width the other way, to the back. Before the distending force can break the press, it must start a crack in the broad throat by actually pushing it asunder; for the deep rib, behind, so braces it, that no leverage is had by which to pry its own jaws apart.

The main frame of the punch press must have the qualifications of a clamp, and have strength proportionate to the power exerted within its jaws, and to this end the metal is formed in the shape of a beam of T-sectional form, bent in a semi-circle, with the broad part inside. Experiment has proved that, although beams of this shape will deflect the same under the same pressure, whether it is applied on one side or the other; yet they will break with a tensile stress proportionate to the surface exposed, the more readily as this surface is less. It is said that experiment has also proved that tubes of square or rectangular section are nearly doubled in strength by the addition of a midweb of the thickness of the sides.

It would not appear from these results that beams of I section are much stiffened against edgewise stress by the flanging, although they are stiffened sidewise and made less liable to fracture edgewise in proportion to the width of the flanging. Experiments were made with beams of this description for the draw beams of cultivators and seeders, in the endeavor to get iron or steel in such form as to combine the indestructible qualities of metal with the stiffness which wood possesses in all directions. They were stiff enough edgewise, and sidewise, but offered very weak resistance to torsion. The same is true of channel or U-shaped iron, which is used in the construction of wheelbarrows where this particular weakness is not detrimental. In the form of gas pipe, iron offers the greatest resistance to torson. For lightness combined with all-around strength, and stiffness, probably the quills of a bird give the best example. Gas pipe, flattened, approaches this form. It is imitated to perfection in the sheet steel ribs, on which are stretched the covers of top buggies. Some of these in the joints in the bending, as well, and, in fact, all throughout, are most creditable specimens of ingenuity and skill in design, construction and workmanship.

By corrugating thin metal it is made to present a part of the surplus strength of its width in resistance to the power which would force its insufficient thickness to bend. If one of the triangular pieces of steel represented in the dotted lines of Fig. 1, and which are made of steel $\frac{1}{8}''$ thick and $11\frac{1}{4}''$ long, were taken by a fairly strong man, he could bend it flatwise over his knee, but after it is bent in the shape shown in Fig. 2, he could use it for a crowbar, for it is then in nearly the strongest form in which that amount of steel can be shaped. The object being to get lightness combined with strength in a form required for a certain purpose to be used in combination with the I beams, previously mentioned, led to the manufacture of the piece shown in Fig. 3, which is as near to the strongest form as the case will admit. The process of making it was to cut from $5'' \times \frac{1}{8}''$ steel, plates of the shape between the two outside dotted lines in Fig. 1. These were then divided on the diagonal line into two parts, which were afterwards punched with the four round holes shown in the lower piece. They were then bent in a die under the drop to the shape shown in Fig. 2. From thence they were taken to a hand-fire and the centerpiece was stuck in at a light welding heat. This piece was put in as a reinforcement, for the point being necessarily $\frac{3}{8}''$ thick, and the two sides, each $\frac{1}{8}''$ thick, required a centerpiece of the same thickness to fill the bill. After these pieces were stuck in they were again taken to the drop and struck up on a mandrel $\frac{9}{16}''$ thick in dies of the proper shape, which prevented the sides from opening out when they were struck on the edge. They were readily formed into shape, and were then taken to the punch press, where, with a long punch, the holes from the side which had been punched in the blank, were transferred to the other side, which had not been punched. As they were gauged from the middle hole in bending, this hole of course came central, and a slot punch of the shape shown by the dotted lines and $\frac{9}{16}''$ thick, was introduced into the fold, and punched a slot in the back of the piece, the full width of the fold. If this had been punched before the piece was folded, it would have flared on the edges, and made a very poor job. The job was now neat; the holes were in line and necessarily coincided with each other, which would not be absolutely assured if all of them were punched before the pieces were bent.

When so slight a weld as that described has to be taken, it is not of much consequence whether the steel is high tempered or not. In the cutters of corn planters, and the shoe hoes of grain drills, there is more difficulty. The shoe hoe, shown in Fig. 4, must be made of a steel which will harden in oil, and hence

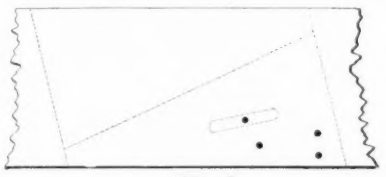


Fig. 1

Fig. 2

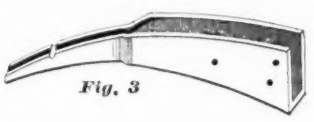


Fig. 3

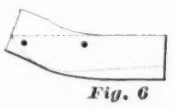


Fig. 6

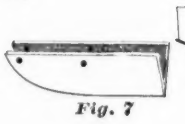


Fig. 7

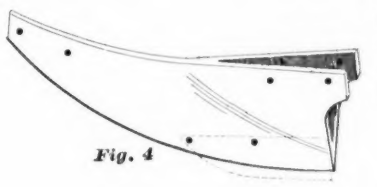


Fig. 4

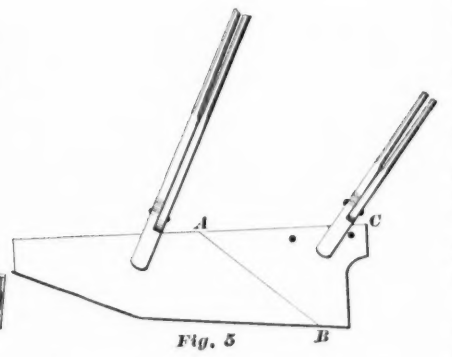


Fig. 5

PRACTICAL DETAILS OF BLACKSMITHING.

is sensitive to high heats, but which must, nevertheless, be made of two pieces in order to form economically, the opening, shown in the wide end, which is for the insertion of the seed-dropping tube. The shapes of the two pieces, which are ordered from the steel works already cut, are shown in Fig. 5. They are of steel $\frac{5}{16}''$ thick, the main piece 18" long by $5\frac{1}{2}''$ wide, and the other, *A B C*, is in the proportion shown. The holes which are represented are required in the finished piece, and the first operation is to punch them, as they are very conveniently placed to fasten the two pieces together. The $\frac{5}{16}''$ iron rivets used to fasten them are only long enough to make a very smalll head. All the duty the rivets have to perform is to keep the plates in place while heating and hammering, and then they are knocked out, and leave the holes true with each side.

Objection is sometimes made to the use of coke in welding these broad, thin plates, on the ground that the fuel is so rapidly consumed that the cold wind finds its way through it, and striking on the hot plate, chills it, oxidizes the surface of contact, and prevents welding, and for this reason some prefer to use anthracite. There may be, however, as much trouble with anthracite coal from the blowing through of free air, as with coke. If the fire is too shallow for the fuel, it will occur, and it will become too shallow if it is allowed to fill up on the bottom with clinker. There is no serious difficulty, with a proper blast, of keeping a good welding fire with coke. The blast does not need to be as strong, and should come through larger grate openings than with anthracite, which takes a sharper blast. If the fire is too thick for the fuel, the air must all be consumed before it gets to the top, and the fuel there, if it does not remain cold, must be heated by the heat generated in the consuming fuel below. A want of attention to these elementary principles is the cause of much trouble.

The smaller plate, after being punched, is scarfed down on the side *A B* at the trip-hammer, and the plates are then riveted together. One of the pieces, thus prepared, is now laid on the coke in the furnace, and heated to redness, when it is laid out, and the lap covered with raw ground borax. This is found to be, on the whole, as economical as calcined, anhydrous or vitreous borax. The heat is then raised with care, and when it is attained, the heater hands it, by the point, to the trip-hammer man, in such a manner as allows him to seize it readily with two pairs of tongs, as shown in Fig. 5. With these he has it at perfect command, while he places and handles it under the triphammer, which is at once set in motion and quickly unites the pieces. The dies are so formed as to make smooth work in the jointing of the two pieces, and a gradual taper to the thickness of one. The edge is thinned down at the same heat. A few blows are all that are needed if the heat is right.

The piece is then laid on the flatting block and straightened. The rivets are knocked out, and it is then taken to the shearman who, while it is hot, shapes up the edges and back, which have become somewhat distorted by the hammering. When nearly cold they are allowed to soak in warm water, to remove the surplus borax, and when dry are run for a short time in the rattler, to take off anything that sticks to them that would clog the grit of the grindstone, to which they are now carried. It is found more convenient to do the rough grinding while in the flat state than after they are bent. They are rough ground either under a breech lever or a long hand lever, and are then ready for bending.

The operations of bending and opening are performed at the same time, and by the same machine. This is a horizontal bending machine, a very useful tool. A good heat is taken on the piece, and the two parts are slightly separated from each other with a chisel. It is then immediately locked in a vise on the machine, the jaws of which are of the shape which the outside of the piece is to assume when it is finished. The machine is put in motion and a "former" comes up at once, and enters the opening in the piece, and gives it the proper shape. The curve of the whole piece is also given at the same time. The tendency of the wide, thin plate is to buckle, rather than upset on the inner side of the curve, but on the outer side the tension draws it straight. The die, therefore, which moves up, to form the inside of the curve, is grooved out, and the edge, being received in this groove, is kept from crimping. They are now punched with the two holes in the heel, for the attachment of the false heel indicated by the dotted lines of Fig. 4. They are then heated in an open fire, so that they may not get hot except where they are to be hard, on the heel, and their propensity to get hard having received a slight stimulus by a dose of cyanide of potash, they are dipped to the proper depth in a tank of oil, and allowed to remain until they are cool. They are then sawdusted to remove the oil, and are then ground on hard emery wheels, wherever they will touch the soil, and are afterwards polished on buff wheels.

Although considerable pains is taken to make these shoes as hard as they can safely be made, yet the constant scouring in the sand through which they are drawn, acts with as much efficacy as a sand blast, and it is only a question of time and use, when they will be worn out on the heel. To avoid the expense of replacing the whole thing, a false heel is made, which is shown in Fig. 7. It is made of sheet steel, and is first folded at the drop, in the shape shown in Fig. 6, and at the same time receives the curved form on the bottom. This makes a solid, unwelded joint in front, directly under where the edge meets, and prolongs the edge of the shoe. This edge is left solid, because a weld continually presented to fine sand, in that position, would be severely tried. The holes are punched, and this curve also brings up the stock, for support in punching the front hole. After punching, the pieces are sheared to shape, the lower back corner is welded and sharpened, and the sides are then opened by a "former," and then the cutting edge is hardened. They are afterwards ground and polished, and when needed are riveted on the old shoe by the purchaser.

Master Car Builders' Association Officers for 1887–'88.

The following officers were elected by the Master Car Builders' Association at the recent meeting:

PRESIDENT: William McWood, Grand Trunk Railway, Montreal, Canada.

VICE-PRESIDENTS: John W. Cloud, Pennsylvania Railroad, Altoona, Pa.; E. W. Grieves, Baltimore and Ohio Railroad, Baltimore, Md.; John S. Lentz, Lehigh Valley Railway, Packerton, Pa.

TREASURER: John Kirby, Lake Shore and Michigan Southern Railroad, Cleveland, Ohio.

EXECUTIVE MEMBERS (constituting, with the foregoing officers, the Executive Committee): F. D. Adams, Boston and Albany Railroad, Alston, Mass.; E. B. Wall, Pittsburgh, Cincinnati and St. Louis Railroad, Columbus, Ohio; L. Packard, New York Central and Hudson River Railroad, West Albany, N. Y.; R. C. Blackall, Delaware and Hudson Canal Co., Albany, N. Y.; R. D. Wade, Richmond and Danville Railroad, Washington, D. C.; Joseph Wood, Pennsylvania Company, Pittsburgh.

SECRETARY: M. N. Forney, 45 Broadway, New York City.

Competitive Valve Gears.

There are at present a half dozen valve gears—more or less—in this country in competition with the link motion for use on locomotives. We have been told for years that the link distributed steam in an exceedingly wasteful manner. Under some conditions the link is not the best arrangement possible for distributing steam, but when used on the locomotive its redeeming qualities appear to more than overbalance its bad features. So far, not one of the competing gears appears to hold its own against the much-abused link.

The link, about as it is made and used, appears to afford a very satisfactory way of making a comparatively small cylinder out of a large one, and this is just what is required in locomotive practice. It is simple enough for the purpose, easily kept in order, and contrives to beat theory out of sight in its practical operation.

Saws for cutting the slits in gold pens revolve 4,000 times per minute.

Extracts from Reports of Committees at the Master Mechanics' Association.

The committee on "Extension Fronts, and Brick and other Fire-Box Arches" consisted of John Hickey, W. A. Foster and E. L. Weisgerber. This committee reported having sent out circulars to the members of the association. These questions embraced: the kind of fuel used; evaporation per pound of coal; average cost per locomotive mile; what form of smoke-box is used; experience, if any, with extension fronts, with dimension of fronts; kind of netting used and its location; situation of deflector plate and situation of exhaust nozzles and arrangement for discharging sparks; kind of smoke stack used with extension front, and, in connection with this, size of engine cylinders, size of nozzles, dimensions of fire-box and number of flues; the propriety of using a single nozzle with the extension front; the use of some other device in the ordinary box to accomplish the same end as the extension front; the use of a draft or petticoat pipe in connection with extension fronts; weight added by extension fronts and attachments. How the old style smoke-box and diamond stack is regarded as compared with the extension front; the use of a brick arch or other device in connection with the extension front; the use of brick or other arch in the fire-box of a locomotive using bituminous coal; injuries to fire-box sheets, if any, from the use of the fire-box arch; the use of hollow stay bolts; all things considered, is the use of extension fronts, as now constructed, to be commended?

The committee says:

To this circular the committee received fifteen replies, and although the information elicited was less than your committee had reason to expect, it was obtained from master mechanics in all sections of the country where bituminous coal is used for locomotive fuel, and may be accepted as representing fairly the experience of members with soft coal of different characters, produced and used throughout the country.

In reply to the circular, Mr. Clem Hackney, of the Union Pacific, states he uses soft coal from the mines of Iowa, Kansas and Wyoming, having an evaporative power of from four to eight pounds of water per pound of coal, and costing per locomotive mile run, 9.4 cents.

He has had a large experience with extension fronts and brick arches in fire-boxes, and while he regards the latter as very beneficial for coal of a light nature, he does not advocate its use for bituminous coal of a heavy quality. He generally uses a straight stack with extension fronts, but has a few engines running with diamond stacks in connection with the extension, giving good satisfaction.

Mr. Hackney does not endorse the use of hollow stay bolts for the purpose of admitting air above the fire, except when the coal used contains much incombustible matter or, when a heavy fire must be carried.

Mr. W. J. Robertson, of the Central Vermont, uses soft coal, capable of evaporating 2½ pounds to 5½ pounds of water to the pound of coal, and costing on an average of 10½ cents per locomotive mile run.

He does not favor extension fronts on locomotives, and says they are more expensive to maintain, with no apparent gain as a preventive of fires or economy of fuel. He showed by blue print a front he advocates, and says: I have twenty engines running with this device, with cylinders from 15 by 22 inches to moguls 19 by 26 inches, and all are working very satisfactorily both as to economy of fuel and riding of engine. In addition to this I am enabled to use a larger exhaust nozzle than with the extension front, as I do not have to exhaust the large amount of dead air contained in the extended arch, hence the blast is decreased on the fire, and less sparks are drawn through the tubes. He has obtained very satisfactory results from the use of the brick arch in the furnace, and assigns as a reason that the gases, having further to travel before reaching the tubes, come in contact with the hot brick, and mixing with oxygen from the fire-hole, promotes more perfect combustion.

Mr. S. A. Teal, of the Fremont, Elkhorn, & Missouri Valley, reports using soft coal. Costs his road per locomotive mile for fuel, 8.82 cents.

He believed in the extension front as they had it, but derived no benefit from the use of brick arch, and could see no advantage in using hollow stay bolts for admitting air above the fire.

Mr. Jacob Johann, of the Texas Pacific, uses for locomotive fuel ordinary soft coal. The cost per locomotive mile for fuel is 12.19 cents. He is using the extended type as ordinarily constructed, and the old style smoke-box and diamond stack, but is replacing the latter with extension and straight stacks as fast as he can possibly do so, as he regards the cost of maintaining to be much less than the old style, and, as a safeguard against fire, is far superior. He says: "As regards the enormous saving in fuel that is claimed for the extension fronts, I have only to say that I consider such statements to be much overdrawn, and that when a road is fully equipped with extension fronts the fuel bills will be found to amount to about the same as they were when the road in question used the old style smoke-box, with the same number of engines and business." He has experimented with a number of devices designed to obtain the same results with common arch and diamond stack, as is obtained from extension fronts, but has not succeeded in any measure in doing so. He does not favor the use of brick arch in furnace, as its advantages are more than offset by the expense of maintaining it, the principal source of expense being due to the injuries of fire-box sheets resulting from the use of it. He has proved by actual experiments that hollow stay bolts used for the purpose of admitting air above the fire under any circumstances are detrimental, and has always found that sufficient air can be admitted through the grate bars for proper combustion, provided the firing is done properly, and concludes with the following: "Taking all things into consideration, I will say that I favor the present general construction of extension fronts, as being more economical in maintenance and as better security against fire."

Mr. T. W. Gentry, of the Richmond & Danville, uses soft coal for locomotive fuel, having an evaporative power of six and one-half pounds of water per pound, costing 9.30 cents per mile for fuel on locomotives in freight service of the consolidation type. He has had over five years' experience with extension fronts on locomotives, and uses them now almost exclusively. He thought them far superior in economy of maintenance, economy of fuel, and preventing fires. He reports using the brick arch in the furnace, held in place by circulating pipes made of extra heavy hydraulic tubing, formed on a curved angle from flue sheet to crown, and finds great economy of fuel results from its use. He considers the single nozzle, properly proportioned, with suitable division plate run up proper distance, a better and more economical exhaust exit than the double nozzle. He has experimented with a device for using a straight stack on short smoke-boxes with netting arrester and deflector plates, but finds it not practical. His experience has shown that very little, if any, good is accomplished by hollow stay bolts above fire line, and does not advocate the use of such for the admission of air.

Mr. Swanston of the Chicago, St. Louis & Pittsburgh, uses soft coal from widely different localities, and by tests finds the Pittsburgh coal to evaporate 7.35 pounds of water, while the coal from the mines of Ohio, West Virginia, Indiana and Kentucky have an average evaporative power of only 6.30 pounds of water to the pound of coal. His average cost per locomotive mile for fuel is 6.5 cents. He uses the extended fronts as ordinarily constructed, together with straight stacks, and is getting very satisfactory results. The cost of maintaining he says is much less, as compared with the old style arch and diamond stack, and while there is but little difference in economy of fuel, he finds the device a safeguard against setting fires on the line. He finds the brick arch very useful in connection with the extension, and is satisfied from experience that its advantages will warrant the use of it. The additional weight on engine truck, caused by extension front and appliances, Mr. Swanston finds to be about 1,200 pounds. He says: "I know of no device that will give the same results as the extension fronts. I have tried the same general arrangement of the smoke-box with short box, that we have in extension front, which was recommended as answering the purpose, but we failed to get the results."

Mr. Frank C. Smith, of the Peoria, Decatur and Evansville, uses soft coal, costing about 3 cents per locomotive mile for fuel. In connection with the extension fronts, we use a stack fashioned after the ejector principle. On a 17 x 24 eight-wheel engine, having 160 2-inch flues, fire-box 66 x 33 inches, exhaust nozzles 4⅜ inches diameter, stack has opening in arch of 22 inches, contracted to 13 inches at a point 17 inches above base, then opening to 15 inches at the top.

He had had experience with a device in the ordinary smoke-box, but it was not satisfactory. He uses a fire-brick arch in furnace having slabs of brick 8 inches thick, supported on arch pipe opening into tube and crown sheets. In placing the brick arch, he leaves a space about 3 inches between that and the side sheets, and a distance of 6 inches between brick and tube sheet. With the addition of an arch in fire-box he finds a saving of 21 per cent. in fuel when used in connection with the extension front. He finds not the slightest injury to fire-box sheets from the use of the brick arch; on the contrary, have not so many leaky flues with it as without. He is prepared to advocate the use of hollow stay bolts only on engines having a large amount of steam-generating power in comparison with the service to be performed.

Mr. James Meehan, of the Cincinnati, New Orleans & Texas Pacific, uses soft coal, having an evaporative efficiency of 7½ pounds of water to one pound of coal. He uses extension fronts and straight stacks in connection with the brick arch. He found a saving of 30 per cent. in fuel, as compared with the old style smoke-box and diamond stack, and a saving of 75 per cent. in throwing sparks.

Mr. W. A. Foster of the Falls Brook Coal Company, has had considerable experience with the brick arch, and considers it a great advantage; "locomotives equipped with it do not throw out the amount of dirt and cinders from the stacks, and do not have to be handled as carefully as when running without the arch. The coal will also lie on the grate and burn more evenly and consume less, especially if it is of light quality. I am not prepared to say what the saving is, as I have never made any tests, but am convinced in a general way that it is considerable. On locomotives with long fire-boxes I do not consider the fire-brick arch necessary. My experience has been with fire-boxes 72 inches long, that the brick arch is a decided advantage, but with boxes 97 inches to 120 inches long, I do not consider the brick arch to be an improvement."

Mr. Daniel McGrayel, of the Chicago, Rock Island & Pacific, favored the extension front; could not say there was any great amount of economy in fuel, but there was a saving in stacks, cones and netting. His extension smoke-box is 60 inches long over all, and the additional weight is about 750 pounds. He reports using brick arch in the fire-box, but it has proved to be of no advantage, and thinks there is no economy in its use.

Mr. G. W. Ettinger, of the Newport News & Mississippi Railway, uses bituminous coal and evaporates 9.6 pounds of water per pound of coal. His cost per locomotive mile is 2.85 cents. He considers one style of front as economical as the other when used without furnace arch. He invariably uses the brick arch in fire-box in connection with the extended front, and declares the expense of constructing and maintaining it to be small in importance, compared with the saving arising from the use of it.

Mr. T. B. Twombly, of the Chicago, Rock Island & Pacific, did not think the extension front of any particular advantage. As at present constructed it was unnecessarily large. The additional weight was just where it should not be, viz., on the truck. Speaking of fire-box arches, Mr. Twombly states: "Many years ago I carefully observed the performance of a number of different engines, part of them equipped with brick arches, and I can safely say that any difference in economy caused by a brick arch was not perceptible. I am strongly of the opinion that, with our Western coal, a brick arch does not pay for its first cost and maintenance."

Mr. Geo. W. Stevens, of the Lake Shore & Michigan Southern, says the fuel used on his locomotives is bituminous coal from mines in Ohio, Indiana and Illinois, and gives an average of about seven pounds of water to the pound of coal for all classes of service, and costs on an average 4¼ cents per locomotive mile for fuel. He uses the fire-brick arch on all passenger engines, and he finds a saving in fuel of from 5 to 15 per cent. thereby. It is his practice to use a double row of hollow stay bolts in fire-box for the purpose of admitting air above the fire.

Mr. E. M. Roberts of the Ashland Coal and Iron Company, of Ashland, Ky., uses ordinary extension fronts. He uses a deflector plate fastened to top of tube sheet in the usual way, but carried from the latter at an angle of about fifty degrees. The lower edge of plate is at a distance of 19¾ inches from tube sheet, and is ten and one-half inches from bottom of smoke arch. The front end is lined with rings of asbestos mortar, and this in turn is covered with sheet-iron divided into sections that can pass easily through the door. He uses a brick arch in the furnace placed on angles fastened to side sheets, and considers it a great advantage both as to steaming and preventing smoke-box filling up with cinder.

Mr. Wm. Wilson, of the Chicago & Alton, uses bituminous coal, having an evaporative capacity of five pounds of water per pound of coal; cost per locomotive mile 4.91 cents. He favors the use of brick arch, but does not advocate the use of hollow stay bolts. He uses the single nozzle, and believes, from experience, that its use is much more desirable than that of the double nozzle.

The committee in its report note some experiments made with an extension smoke-box and fire-box arch. The start was made with a straight stack, equal in diameter to the diameter of the cylinder. Double nozzles were used. This arrangement proved to be a good spark arrester, but not a free steamer. Enlarging the brick arch in the furnace, permitting a small quantity of air to enter at the fire door, and adding a deflector plate over the furnace door inside the fire-box resulted in doing away with black smoke, but resulted in no other improvement. Then the inside diameter of the stack was reduced from 16 to 14 inches. This improved the steaming, and reduced slightly the coal consumption. A single nozzle was then tried, and slightly better results were obtained. The stack was then enlarged at the top, making it 18″ at top and 14″ a few inches above the base. This made a marked improvement so far as steaming was concerned. Finally, the contracted front of the stack was made 13½ inches diameter, with improved results.

Finally, the diameter of the stack was decreased to 13 inches, which was found to be the best diameter for 17″ x 24″ cylinders. Soft coal was used. Single nozzles 4¼ to 4½ inches were used for 17 inch cylinders, and 3¾ to 4 inches for 16 inch cylinders. The petticoat pipe was found to be of no particular advantage with the single nozzle.

The brick arch in the furnace we found by experiment to be a great improvement in promoting more perfect combustion and increasing the heating quality of the coal from 5.8 pounds of water per pound of coal, as tested, without the arch, to an evaporation of 6.3 pounds of water with the arch in use.

The committee calls attention to the fact that the best construction is, in a great degree, dependent upon the kind of fuel used, and that no fast and loose rules will apply.

The committee favor extension fronts for burning bituminous coal. The committee says:

"The additional cost of construction, the slight increased weight thrown upon the truck, and the more trivial objection that the construction interferes with the process of washing boilers from the front end, are of

minor importance, and deserve but little consideration, if it is established that such departure from the old style serves any useful purpose and accomplishes any valuable result."

The committee also expresses itself as favoring the brick arch, both on account of economy of fuel and smoke prevention.

In regard to hollow stay bolts the committee is non-committal. The committee says:

The velocity of draft and rate of combustion are some of the most important elements pertaining to the consumption of coal. To the rapidity of combustion in locomotive fire-boxes is due, perhaps, more waste of fuel than from any other source. It appears from experience to be impossible to extract from the coal its full heating value when the rate of combustion exceeds ninety pounds per square foot of grate surface per hour, and far more economical results were obtained when the rate was much less than the figures named. In order to utilize to the best advantage, therefore, the material necessary to the formation of steam, that is to say, the air and the fuel, the fire should not be forced, but an augmented grate area, with a correspondingly increased furnace, are the necessary substitutes. The superiority from an economical point of view, of slow over rapid combustion, has repeatedly been shown by experiment. One case coming under the direct observation of your committee, where, with a forced fire, in order to get the engine to produce sufficient steam for her work, the evaporation was only 4½ to 5 pounds of water per pound of coal, whereas with an increase of 20 per cent. in furnace and grate surfaces to the same cylinder, and performing similar service, the evaporation rose to 6 pounds.

And in regard to smoke: Smoke is also a product of incomplete combustion, the entire prevention of which under circumstances of a rapid rate of combustion, is attended with great practical difficulties; in fact, under such circumstances it seems impossible to accomplish. It has been proven beyond question that smoke once formed cannot be consumed. What is needed, therefore, is not a smoke-consuming, but a smoke-preventing furnace.

Every act leading to the proper combustion of coal takes place with increased ease, facility and completeness, as the force of the draft is lessened within certain limits; as the temperature in the furnace is more elevated and uniform; as the charges of fresh fuel are lighter and more regular; as the correct amount of air is admitted at the proper time, and as the contact is more intimate between the air and fuel.

The great variety of kinds of fuel, although containing nearly the same ingredients, but in many different proportions, it is true, renders it a difficult task to arrange mechanically the means of utilizing all to the best advantage; but to lack of appreciation of the above-mentioned facts, and of interest in the principles involved, is chargeable much waste of money, confusion of ideas and disappointment.

ADVANTAGE OR OTHERWISE OF USING THICK TIRES.

The committee on this subject consisted of J. W. Stokes, H. Scholock and C. E. Smart. Their circular to members brought out several replies.

Mr. Clem Hackney, of the Union Pacific, says: Four inch finished is now our standard thickness for all new tires put on, but so far we do not find their use appreciably reduces the quantity of sand used.

Mr. C. E. Smart, of the Michigan Central, did not think the heavy tire noticeably increased adhesion.

Mr. Clem Hackney thought the manner of handling the engine, especially in switching, had considerable effect on the life of tire.

Mr. C. E. Smart was satisfied that the life of tire could be prolonged 25 per cent. by a careful, competent engineer, as compared with the engineer who took no particular interest in his work.

Mr. Francis R. F. Brown, of the Canadian Pacific, says: In my experience the engineer to a very large extent has the life of the tire under his control; given two locomotives equal in weight and dimensions and with the same make of tire, and the engineer of one being a careful, intelligent man who studies the interest of the company which he serves, and the engineer of the other being of the class who only care to draw their monthly pay, the first named will make his tires last three times the life of the second, with a consequent saving of fuel, wear and tear, and economy in repairs.

Several other members spoke of the great influence of a careful and skillful engineer over the wear of tires.

Mr. T. W. Twombly, said, in reference to increasing the size of wheel centers, that he preferred to put the weight where it would be relieved by springs.

Mr. C. E. Smart submitted a table going to show that the wear of tires was materially greater with heavy than with light wheel centers.

Many other replies were received, mostly unfavorable to the use of heavy wheel centers.

The committee concluded that there was not as yet sufficient data from which to form definite conclusions, and recommended, that the work of the committee be continued, or a new committee appointed.

TRACTION INCREASERS.

The committee on the subject of traction increasers for over-cylindered engines, consisting of J. Davis Barnett and F. L. Wanklyn, received ten replies to their circular. To the question: Can the defect of an over-cylindered engine be best remedied by the application of a traction increaser, all gave an emphatic negative. Some of those replying advocated bushing the cylinders, and others preferred adding dead weight.

Mr. Barnett, of the committee, gave an account of experience with a traction increaser on the Grand Trunk. The engine was of the ordinary American type, four wheels coupled, cylinders 17″×24′, driving wheels 5 feet 3 inches diameter, boiler pressure 135 lbs. The total weight of engine was 71,060 lbs., of which 27,130 lbs. was on the truck, 23,130 lbs. on the drivers and 20,800 lbs. on the trailers. Mr. Barnett says:

"The traction increaser was guaranteed to enable the engine to haul 33 per cent. greater load than formerly. In one experiment I rode on the engine myself. She hauled behind her 18 loaded and 22 empty cars, including the van, the usual load being 23 loaded cars. The engine hauled the load up the controlling grades of the division, but straining itself to such an extent that I was convinced that a traction increaser would soon send the engine into repair shop, and the results have shown that my conclusions were not unfounded.

"The traction increaser was applied in October, 1886, the engine at that time being in good order. In January, 1887, after having run 11,000 miles, with the traction increaser hauling heavy loads, the engine came into repair shop with a broken main frame, two broken horn blocks, broken saddle casting, broken right driving crank-pin and broken cylinders. The fractures in the latter were close to the flange through which they are bolted to the saddle casting. These repairs were executed and the use of the traction increaser continued with a somewhat lightened car load. The following April the engine was returned to repair shop, after having run 4,250 additional miles, for a new axle and new right driving crank-pin. It will thus be seen that the engine was severely damaged after having run but 15,250 miles with a traction increaser. The traction increaser remains on engine No. 172, but instructions have been issued not to haul more than the average load for engines of that class, and we have since then had no special trouble."

PREVENTION OF DANGEROUS ESCAPE OF LIVE COALS AND SPARKS FROM LOCOMOTIVE ASH PANS.

G. W. Ettenger, for the committee, submitted a report on this subject. The committee took the ground that a departure from the present practice in the construction of ash pans was advisable. Any kind of a workman was considered good enough to make an ash pan. The whole affair is put together in an airy, "bird-cagey" fashion.

The committee recommended that a standard ash pan and grate be adopted, and that the ash pan be as well made as other parts of the locomotive.

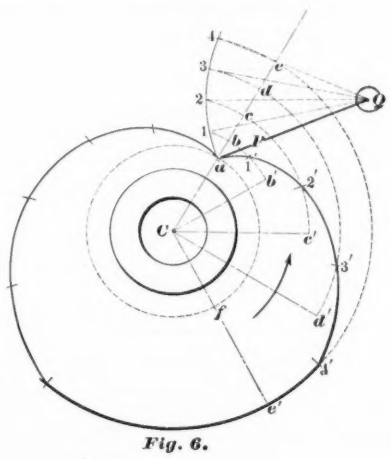


Fig. 6.

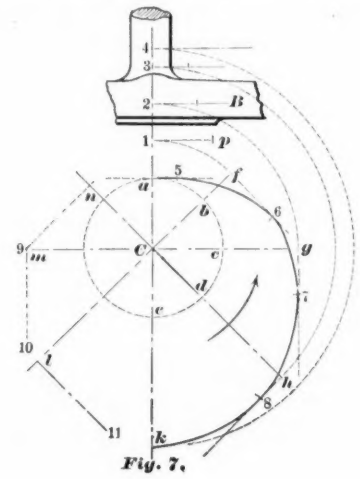


Fig. 7.

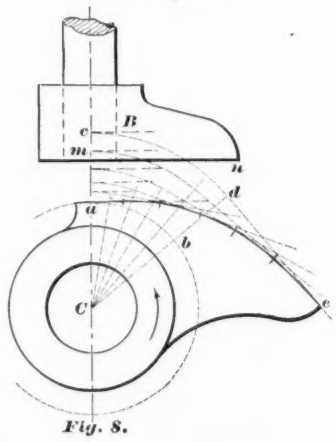


Fig. 8.

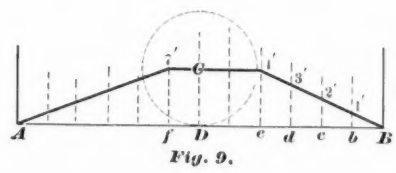


Fig. 9.

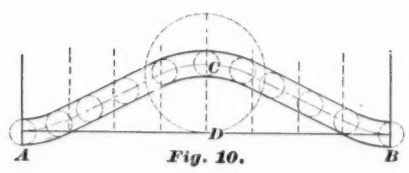


Fig. 10.

LAYING OUT CAM CURVES.

The *Engineering and Mining Journal* says:

The average annual production of Bessemer steel in this country per converter was, in 1886, 34,907 tons, and in England 20,134 tons. In 1887, the average yield per converter increased in England to 24,635 tons, while in the United States it was 36,940 tons, or fifty per cent. greater than in England. And yet this enormous superiority in output per given plant is accomplished with even fewer men than are employed in England, so that in reality our output per man is greater than that in England, by more than fifty per cent.

Producers of petroleum in this country have just planned a gigantic "shut down" to increase price, and, strangely enough, Russian merchants have chartered the greater part of the vessels constructed for carrying petroleum.

Laying Out Curves for Cams.

BY PROF. A. T. WOODS.

SECOND PAPER.

In the illustration given in a recent article on this subject, the path of the driven point was assumed to be a straight line. The construction is the same, however, whatever may be the path of the point. For example, in Fig. 6, let it be required to construct a cam curve which will transmit a motion similar to that of Fig. 3 (AMERICAN MACHINIST, June 23,) to an arm $P\,Q$, which is to vibrate about a center Q. Assuming, as before, that the point or end of the arm is to be raised from a to 4 at constant speed, while the cam turns through ¼ of a revolution, divide the arc in which the point moves into say four equal parts, and the arc $a\,f$ into the same number. Then find points on the curve in the same manner as before, by laying off $b'1'=b1$, $c'2'=c2$, $d'3'=d3$ and $e'4'=e4$, and the curve $a\,1'\,2'\,3'\,4'$ is the required curve. The remainder of the cam curve is found in the same way, the construction lines being omitted in the figure, to avoid complication. It is clear that the same method of construction would be applicable whatever the location of the center Q, or even if the path of the point is some irregular curve. When there is a fixed center, such as Q, it must, of course, be so located with regard to the cam that the latter will clear it and the arm in all positions. It will be seen that the proportions chosen for Fig. 6 would not be satisfactory, because the center line of the arm when at 4 Q intersects the largest circle, and hence the cam would strike the arm if the latter were straight. This difficulty can be overcome by bending the arm $P\,Q$, by raising the center Q so that the arm vibrates through a greater arc below the horizontal line 2 Q than above it, or by making the cam in the form of a slot in the face of a disk or plate, and making the pin or roller project from the arm perpendicularly to the paper.

We will now examine the form of cam motion in which the cam acts upon a flat surface, such as the face of a "lifting toe," or that of a yoke which rests upon the cam. In Fig. 7 let C be the center about which a cam is to turn through a half revolution and lift a piece B from a to the positions 1, 2, 3 and 4 while the cam turns through the arcs ab, bc, cd, and de. When the cam has turned through the arc ab, Cb will be in the vertical center line $C4$, and the face of the piece B will be in the position indicated by the line drawn through 1 perpendicularly to the center line. If the cam is made so that it just touches the line $1p$ at any point, or is tangent to it, the desired result will be obtained. Therefore if we lay off $Cf=C1$ and draw $f\,6$ perpendicular to Cf, the only essential condition, so far as this position is concerned, is that the cam curve shall touch $f\,6$ at some point, such as 6.

Another condition is that, in the position in which the cam is drawn, the curve must not rise above the horizontal line through a, or the tangent to the base circle at that point, since in its lowest position B rests upon the cam at a.

Proceeding to the successive positions 2, 3 and 4, we lay off $Cg=C2$, $Ch=C3$, $Ck=C4$, and draw perpendiculars to the radial lines at g, h and k; we can then complete the cam curve by drawing it tangent to these last lines. In the figure it has been further assumed that, after the half revolution of the cam, the point of contact between the cam and piece B is to be on the center line, therefore k is a point on the curve. An examination of the figure will make it clear that, according to this construction, the point of contact moves from the center line out along the face of B until it is at a distance $f6$ to the right of the center line, when Cb arrives at Ca. It then moves back toward the center line, since, as drawn, $g7$ is less than $f6$ and $h8$ is less than $g7$ until, on the completion of the half revolution, it is again on the center line at k. The necessary length of bearing surface on B is therefore equal to $f6$.

When a cam of the form shown in Fig. 7

is to make complete revolutions and drive in both directions, it may be enclosed in a yoke, of which the two working faces are the distance *a k* apart. To complete this cam to work in such a yoke, we proceed in much the same manner as for a cam which is to work between two rollers. Lay off *Cl=ak—Cf*, *Cm=ak—Cg*, etc., and draw perpendiculars to these lines as *n*9, *m* 10 and *l* 11. If we now complete the cam by drawing a curve tangent to these last mentioned lines, it will work in the yoke as required, since the distance between parallel tangents to the curve, such as *n*9 and *h*8, *m*10 and *g*7, is constant and equal to *a k*. As has been before stated, to secure satisfactory results the drawing should be to a large scale, and many points found.

In a construction such as just described there is, of course, considerable sliding. This can be reduced to a small amount by connecting the cam to the driving mechanism so that it shall vibrate through a small angle. For example in Fig. 8 the cam is to turn through the arc *ab* of the base circle, and lift the piece *B* from *a* to *c*. The method of construction is the same as in Fig. 7, and is clear from the figure. It will be noticed that the point of contact gradually moves away from the center line until it is at a distance equal to *d e* at the end of the motion. The length of face of *B* or *m n* should therefore be equal to *d e*. By reducing the angle through which the cam is intended to vibrate still further, the curve can be made still flatter, and therefore more nearly equal in length to the face of the lifting toe, the amount of sliding being correspondingly decreased. This form of cam motion will be recognized as that used in Stevens' cut-off motion.

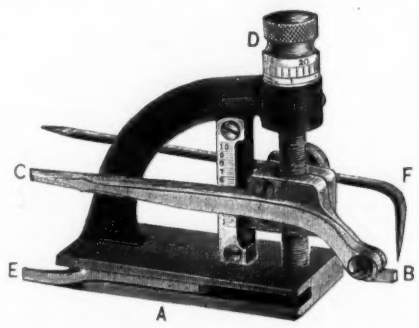
When the motion to be transmitted by a cam is rapid, and there are abrupt changes of direction, as at *a*, Fig. 6, the plate cam there shown may be advantageously replaced by one consisting of a helical groove cut on a cylinder, the motion of the point being parallel to the axis of the cylinder. In Fig. 9 let *A B* be the length of the circumference of a cylinder whose radius is *C D*. Then *B* 4′ 7′ *A* is the development of the center line of a groove, which, if cut on a cylinder of radius *C D*, would give the same motion as the cam of Fig. 3, and very nearly the same as Fig. 6. To obtain this line, divide *A B* into twelve equal parts. Then *B e* equals four of these parts and corresponds to the $\frac{1}{3}$ revolution, during which the cam is lifting. Lay off *e*4′ equal to *a*4 in Fig. 6. As the speed of lifting is constant, the helix which is to control the lifting will be of constant pitch, and its development will be a straight line 4′ *B*. The period of rest will be obtained by a groove of which 4′ 7′ is the developed center line, drawn parallel to *A B* and covering three divisions of that line. The descent at uniform speed will be obtained by a helical groove of which 7′ *A* is the developed center line. If we form a templet in thin metal, shaped like Fig. 9, and wrap it around the cylinder so that the line *A B* forms a circumference, and the points *A* and *B* coincide, the side *A*7′ 4′ *B* can be used to mark the center line of the desired groove. This groove is simply a left-hand screw thread for $\frac{1}{3}$ of a revolution, and a right-hand thread for $\frac{5}{12}$ of a revolution connected by a circumferential groove.

If the speed of lifting is not uniform, the amount of lift desired at each point, *b*, *c*, *d*, etc., must be laid off on the vertical lines *b*1′, *c*2′, etc., to find points through which the helix should be drawn. With this construction there would be a sudden change of direction at *A* or *B*, which can be diminished by increasing the diameter of the cylinder for any given lift. In many cases a certain amount of lift is desired, but the intermediate positions are of no importance. We can then, as shown in Fig. 10, make the helix of varying pitch such that the desired motion will be without sudden changes of direction and consequent shocks. The developed pitch line of the helix may be a continuous curve or a combination of curves and straight lines, as shown dotted in the figure. The method of finding the shape of the edges of the groove is also clearly shown in the figure.

A New Measuring Instrument.

The accompanying illustration shows a tool which combines a micrometer caliper both outside and inside, a surface gauge, scratch block and depth gauge. It may be used to set a planer tool to plane any given size, and also for measuring a planed piece without removing it from the planer bed.

It consists of a micrometer screw mounted in the main casting and carrying a vertically movable nut. This nut has fore and aft projections, to the former of which is pivoted



a lever *B*, whose longer and pointed end stands against the projection of nut at *C*, and is normally held by a light, double-acting spring at the central line, as shown.

To set a planer tool, adjust the end *B* to proper height and bring the tool down until the point *C* will indicate, by a slight motion, the contact. To measure the piece after it is planed, the part *B* is brought down onto the work until the point moves slightly, when, by reading the screw in connection with the vertical graduated bar, the thickness may be determined. Of course allowance must be made for thickness of projection *B*, which is $\frac{1}{8}$ inch. By swinging the bar *E* around under *B*, the two may represent the legs of a caliper, the distance between them being read from the bottom of nut where it crosses the graduated bar, and in using the tool as an inside caliper read from top of nut, which equals the combined thickness of *B* and *E*. Extensions of different lengths are made to attach to *B* when used as a depth gauge, and also to increase the capacity of tool in either direction.

The scriber, which may be placed on back of nut, as shown, makes a convenient and easily adjustable surface gauge, and as a "scratch block," the screw furnishes an accurate means of marking two or more parallel lines, the distance between which may be as desired, within a minute fraction.

The maker is Wm. Haddow, Newton, Mass.

Emery Surfacing Machine.

The engraving represents a new machine for both special and general machine shop work. It is what may be termed an under surfacer. The work is securely fastened to the platen by either bolts, straps or vise chuck. The work is then brought up to the wheel by means of the stand-screw underneath the platen. The platen is then reciprocated by means of the hand lever so rapidly as to avoid heating of the work. At the same time the work is fed out and in across the under surface of the wheel by means of the feed screw. This enables the operator to regulate the feed or cut to suit the work. The work being secured firmly to the platen, which is gibbed so as to permit no jumping, insures a good surface.

The platen can be set to an angle of 30°, thereby enabling the operator to grind a bevel surface. The machine is adapted to grinding gibs, keys, straps, surfaces and bevels as well as a variety of other work. For grinding chilled and hardened surfaces it is a very convenient tool. It is also made to use a cupped wheel when desired. The hand movement is generally preferred, on account of its greater rapidity of work. The centers of ordinary emery wheels can be utilized on this machine when they are worn so small as to require a higher speed. It has steel shaft $1\frac{7}{16}$ inches in diameter, with 4x4 inch pulley between the bearings. The bearings are 6 inches in length. Floor space, about 24x30 inches. It should be speeded to suit quality and size of wheel. It will take a wheel from $\frac{1}{2}$ inch to 4 inches in thickness.

The machine is made by the Sterling Emery Wheel Co., 17 Dey street, New York City.

The Hall Lathe Dog.

The illustration represents a very simple and quickly adjusted lathe dog, made by the Hall Mfg. Co., Twelfth and Buttonwood streets, Philadelphia. Its capacity is from $\frac{1}{4}$″ to $2\frac{1}{2}$″, and the adjustment is readily made, simply by sliding the bar up to the work and turning the lock-bar upon the back, so as to engage the teeth cut upon the pieces which correspond to the screws in the ordinary dog. It is then made fast to the work or arbor by tightening the set screw.

The makers state that the tenacity of the dog has been tested in the most thorough manner by turning with it a piece of 2″ machinery steel down to $\frac{3}{4}$″ without any slip or twist.

LETTERS FROM PRACTICAL MEN.

An Acknowledgment.

Editor American Machinist:

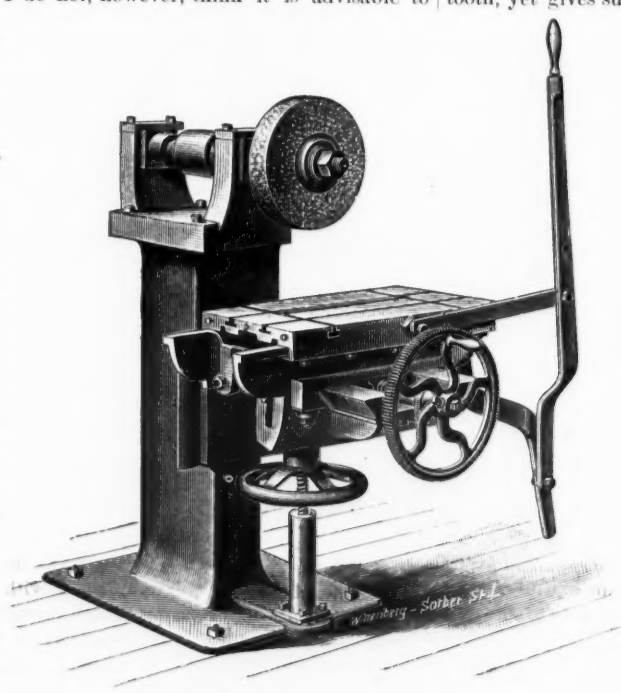
It is a pleasure to have one's work attract attention, be copied and complimented, but the pleasure to me does not equal the pleasure of having a blunder corrected as has been so nicely done by Frank H. Richards, in the case of the erroneous statement made by me, "that all the power used to spring a punching machine frame was a dead loss." That was one of those beautiful theories that would have been very nice if it had happened to have been true, but not being true, goes to prove that one of the easiest things in this world to do, however one may strive to avoid it, is to make mistakes.

John E. Sweet.

About Reamers.

Editor American Machinist:

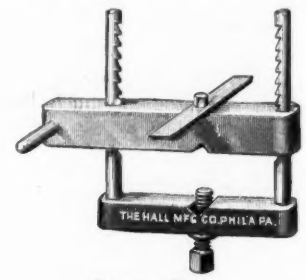
I was considerably interested (and I might also say somewhat instructed) by Mr. Frank H. Richards' article on reamers in your issue of June 2, and heartily endorse his views, as the making of them in the shop, and keeping not only them, but the other shop tools, up to some standard as to workmanship and proportion. I do not, however, think it is advisable to confine oneself to the following of the proportions for tools adopted by those who are in the business of making them, for the reason that it is not always convenient, nor always advisable when convenient. A better plan for securing uniform proportions for shop tools was shown by Fred J. Miller, in an article treating of this subject, in your issue of Dec. 3, 1887, and any one who has ever tried the plan there shown, as I have done, will hardly fail to appreciate it.



Emery Surfacing Machine.

My experience with reamers, so far as the amount of variation in the spacing of the teeth is concerned, agrees with Mr. Richards, and I think that almost the smallest possible variation is just as effective in preventing chattering as any greater amount.

The plan I have followed in spacing, while more simple than that given by Mr. Richards, and more easily kept track of on the machine, is just as effective. It is not really necessary to commence and go clear around a reamer, making each tooth slightly larger than the next one, but the spacing may be gradually increased until half way around, and then commence over again, so that there will be two series alike, and each one extending half way around the reamer. In that case each tooth is just like the one diametrically opposite it, but is unlike any other one. Then, instead of turning the index pin past a certain number of holes greater or less



Lathe Dog.

than the normal movement, I move it always the number of holes called for by the plate I am using, and then push in the pin which holds the index plate, and turn the plate back and forth a constantly and regularly increasing or decreasing number of holes. Thus, in cutting such a reamer as Mr. Richards speaks of, having fourteen teeth, I should first cut one tooth, and then turn it half way round, and cut the one opposite, which is like it. Then I would give the index pin its normal movement (two turns and thirty-six holes) for the next tooth; then, after cutting the one opposite again, I would again give the index pin its normal movement, and then move the plate one hole in the same direction.

On the next pair of teeth the plate would be moved two holes. The next, three, etc., until about half the teeth of each series were cut, then, moving the index pin as before, commence moving the plate back by a constantly increasing number of holes in the same manner. This method, while it gives less variation between the smallest and the largest tooth, yet gives sufficient to prevent chattering, though the plan of moving the index plate, instead of making variation in the movement of the pin, can be used, whether the reamer is to be divided in this way or in Mr. Richards' way.

I am sorry to see him telling how to space a reamer having thirteen teeth, for the reason that a reamer having that number, or any other uneven number of teeth, is an abomination, and ought never to be made at all by any method whatever. It is impossible to measure it, so as to grind it to size, without a ring gauge, which is just the size you want the reamer to be; and even then it is not a very satisfactory process. And then, when it becomes worn, no one can tell how much too small it is without first reaming a hole with it, and then measuring the hole. The man who makes a reamer, or a tap, or any other tool which must be occasionally measured, and puts into it an uneven number of teeth, thereby invites the condemnation of those who must use it; he richly deserves that condemnation, and he will surely receive it.

T. A. Pandie.

Editor American Machinist:

Your correspondents, in discussing the question of reamers, touch upon a matter which

is very close to the heart of every machinist who has any appreciation of the subject of standard sizes, especially if it is his business to maintain them, and still more especially if he has to pay for the tools necessary to maintain them.

Every mechanic knows that with a complete system of standard sizes in the shop, and tools for maintaining them, the chief burden falls upon the reamers; for, if the holes are standard, the shafts and studs fitted to them must be, and so, aside from the gauges, and considering the cutting tools only, the maintenance of standard sizes depends most upon the reamers.

The main difficulty attending their use is, as stated by Mr. Beach, the rapid wear taking place by even the fairest and most careful usage, and which soon reduces them below the limit of variation allowable, unless the work is of such a character as to admit of a large limit of variation—much larger than was possible in Mr. Beach's work.

Where the limit of variation which is admissible is large, say .003", there is little trouble in keeping within the mark by the use of ordinary solid reamers, but there are comparatively few classes of work, especially in the manufacturing line, where so much variation is admissible; and where the limit is .001" or less, as it often is, the problem of making the tools and of paying for them becomes a serious one.

A great many mechanics have no faith in anything but a solid hand reamer, and there is undoubtedly some foundation for the position taken by them, for most adjustable reamers are failures.

Where, for any reason, nothing but solid reamers are to be used, the main point to look after in maintaining standard sizes with them, is to see that they are well made, and of the best obtainable quality of steel.

The cost of the steel of which a reamer is made is usually quite small in proportion to the cost of the skilled labor necessary to make it, and it is a great mistake to select an inferior quality of steel just because it is cheap, when, by using such steel, it becomes necessary to make from two to three times as many reamers, to keep a certain number of holes up to size, as would be necessary if the best steel is used.

It is strange, but, nevertheless, a fact, that, in a vast majority of cases, the best advice which can possibly be given to those who are having trouble in keeping up standard sizes is, to pay from two to three times as much for their steel, and see that they get a correspondingly better quality. Probably a fair average statement of the matter would be that a grade of steel used for reamers, costing twice as much as that formerly used, would not increase the cost of the finished tool more than 10 per cent., and I have frequently seen such a change result in from one hundred to two hundred per cent. increased efficiency, computed from the actual comparative number of holes reamed before reaching the limit of variation. Cheap steel, like cheap labor, does not pay. And this is true of steel, not only when used for making reamers, but for any other tools, where a large proportion of the cost of the tools is for labor, or where the breakage or wearing of the tool beyond the allowable limit causes delay or inconvenience. Of equal importance with the quality of the steel used is the manner of making the reamer, which should, of course, be first-class in every particular. Especial attention should be paid to the clearance or "backing off." It should not be excessive; and any more than is necessary to "just clear" is excessive.

A common mistake in backing off reamers is to use a wheel which is too small in diameter. As large a wheel as possible should be used, because with a small wheel, although the back edge of the "land" may be only very slightly below the cutting edge, yet, owing to the curve of the wheel, there will be excess in clearance immediately back of the cutting edge, which leaves it insufficiently supported, and it soon wears off.

Mr. Beach's plan for an adjustable reamer would be very good, I should think; at any rate his word is good evidence, since he shows a practical knowledge of the subject. Some mechanics, however, object to such a reamer, or, in fact, to any adjustable reamer, because the men using them are liable to change the adjustment, and thus spoil work.

But this, it seems to me, is rather a reflection upon the management of the shop, than upon the adjustable reamer.

I think he will find, upon further investigation, that, in grinding this reamer, his wheel did not jump into the cutter, but the cutter jumped into the wheel.

In grinding along the edge of such a light piece of steel, the edge is liable (unless great pains are taken to prevent), to become heated, and, of course, expands; this makes that edge longest, the other being kept cool by the surrounding metal. The result is that the piece is bent and drawn out towards the wheel in the middle, and the more it springs from this cause the heavier the wheel cuts into it, and the hotter it becomes, and then is "when the temper is drawn, both in the cutter and in yourself."

The same difficulty is frequently encountered in grinding slender reamers which are solid, and water is sometimes used to avoid it.

FAY.

A New Method of Holding Test Specimens.

Editor American Machinist:

In testing cast-iron on tensile strength, the usual method of holding the ends of the test-piece by clamp wedges is liable to bring a bending strain on the specimen, and therefore give inaccurate results.

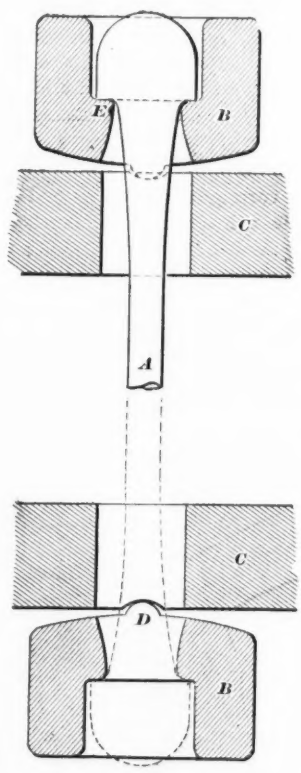
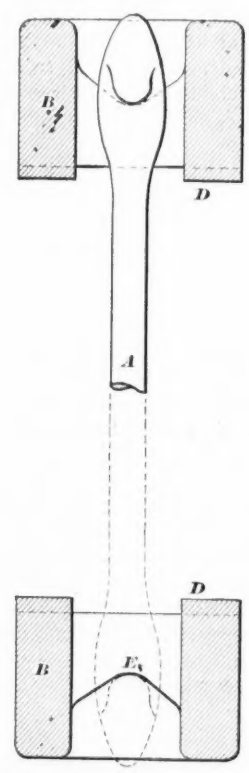


FIG. 1. METHOD OF HOLDING TEST SPECIMENS. FIG. 2.



To obviate this, and insure a straight central pull in the specimen, I designed the device shown in enclosed sketch, and as it is very simple, and can be adapted to any testing machine, I give it for the benefit of those of your readers who may be working in that line.

Referring to the drawing, the specimen or test-piece, *A A*, Figs. 1 and 2, is cast with a flat or oval head on each end, the rounded projections of which rest in bearings in the holding blocks *B B;* these in their turn again resting against the pulling heads *C C*, of the machine. As the bearing surfaces on top and bottom of the holders are at right angles to each other, the specimen can thus rock and adjust itself automatically in all directions. The holding blocks, or at least their bearing surfaces, *D* and *E*, should be hardened (chilled) to stand the wear. It will be understood that the blocks have elongated apertures large enough to pass the head of specimen through, which then is turned round 90° and dropped into its bearings. This device has been tried with excellent results in testing cast-iron on tensile strength.

H. FLADVA.

Camden, N. J.

That Spring Wheelbarrow.

Editor American Machinist:

In your issue of June 23 a communication from neighbor Elliott, in regard to spring wheelbarrows, attracted my attention.

If friend Elliott wants any assistance in proving priority over any "born since the war" patentee of spring wheelbarrows he can apply to me, for I have one at my residence made about twenty years ago—an exact counterpart of the one described by Mr. Elliott. And a good one it is, too. Therefore I do not borrow or lend, for I want it to last twenty years longer.

J. H. WALKER.

Newtonville, Mass.

That Tap Question.

Editor American Machinist:

J. P. L., in the AMERICAN MACHINIST of June 16th, relates some interesting experience with a large tap. The tap had a pitch of $\frac{1}{10}$" or 10 threads per inch, and 8 rows of teeth.

In starting the tap, it was forced forward too hard by its own weight, or otherwise, and each tooth followed in the track made by the tooth ahead of it in the "next story below," or the next pitch below. If J. P. L. will wind a string between the teeth on that tap, advancing the string into the next pitch at each row of teeth, he will find nine teeth or nine pitches between strings, which, after all, is a gain of but eight pitches over the natural pitch of the tap. He will also observe, on close examination, that it started eight threads instead of nine threads, as stated by him. In other words, there were eight separate threads in the hole tapped. I had a similar experience one time with a large tap with six rows of teeth which ran at the rate of seven pitches instead of one.

In like manner a tap with four rows of teeth might make five pitches; more correctly speaking, might make a nut with a pitch five times as great as the pitch of the tap. And it would not be impossible for a tap with four rows of teeth to thread a nut with a pitch nine times as great as the tap. The tap in question, with too much clearance and long distance between rows of teeth, might pitch a nut $1\frac{7}{10}$" or $1\frac{7}{16}$".

J. E. MCCONNELL.

[Later we received the following:]

Editor American Machinist:

In endeavoring to explain J. P. L.'s "curious behavior of a tap," I have been guilty of some curious behavior myself. J. P. L. has stated the facts, and I have erred in saying that the tap started but 8 threads instead of 9. I see clearly now that a 10-threaded tap running ahead at a rate equal to 9 of those threads per revolution, must, necessarily, cut a horizontal plain at 9 places with the teeth of the tap.

J. E. MCCONNELL.

General Mechanics.

Editor American Machinist:

In your article under the above heading, in the issue of June 9th, I think you advocate sound principles, but I think it should be qualified to some extent. I know that in many places such mechanics are in great demand, and it is very aggravating to be refused work because you can do but one kind of work.

I remember a man who came to a shop where I was working, in answer to an advertisement for a "*first-class wood-turner*—no others need apply," when the following conversation took place.

"We want a first-class turner—one that will not be stuck on any kind of work that may be brought to the shop. We will pay high wages. Can you fill the bill?"

"Yes, sir, I can."

"We don't have turning enough to keep a man turning all the time. Can you set up knives on and run a matcher?"

"No."

"Can you run a scroll-saw?"

"I can do either of the things you mention, but not in a first-class manner; therefore I say no."

"We don't want you to do this other work in a first-class style. We have other men that can do the fine work. You had better come and work for us, and after a while you will learn to run the whole establishment."

He did go to work, and did learn to run the whole establishment.

In some places in the West where I have been, the general mechanic is the favorite. Of course he is expected to be a master, and sometimes an expert at something. In country saw-mills the engineer is sometimes required to be first-class, and is also expected to do blacksmithing, millwrighting, boiler-making and tinsmithing; yes, and pipe-fitting, brick-laying and saw-filing. I don't mean to say that a man must be a shoemaker, a blacksmith and a baker; but he may be a first-class machinist, an average moulder, and quite handy at blacksmithing. An apprentice should learn to be a thorough master of his trade before he should allow himself to try anything else; then only something similar. For instance, a cabinet-maker may try his hand at carpenter work.

J. W. POWER.

The *Union Pacific Employes' Magazine* has the following, which may prevent loss of time and money of those looking for employment:

For years the Great West has been the Mecca, but it is anything but that now. There is not a city or town west of the Missouri River that is not overrun with laborers seeking work and unable to find it, and at a season, of all the year, when such should not be true. Denver, Leadville, Aspen, Glenwood, Pueblo, and Salt Lake City all present these conditions.

In our issue of June 9th we published a suggestion from a correspondent, to the effect that vise makers would do well to put on the market a vise with a longitudinal slot along the jaws. Another correspondent writes us to the effect that a certain company that manufacture vises furnish what our first named correspondent wants. Inquiry shows us that what is furnished is not what our first named correspondent suggested. And that is the point in the matter.

The telephone war in St. Louis continues unabated, and Mayor Francis shows no disposition to yield a single point to the Bell Company. The company has already taken out 151 instruments. A proposition to refer the dispute to the courts has been met with a flat refusal on the part of the mayor, who announces his determination to have the poles and wires taken down unless the company complies with the ordinance reducing the rental of an instrument from $100 to $50 per annum.—*Electrical Review.*

There is talk in Paris of supplying the city with water from a lake more than 300 miles away, and at a cost of 60,000,000 dollars.

AMERICAN MACHINIST

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Fred J. Miller, }

Special Announcements.

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☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

☞ *We are not engaged in procuring patent rights, or in selling machinery, nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

☞ *Subscribers can have the mailing address of their paper changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once.*

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NEW YORK, JULY 7, 1888.

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The Fuel Problem.

Some of the leading manufacturers in an Ohio town have recently taken action in a matter closely connected with their interests as manufacturers, which it seems to us is of considerable importance, and is an example well worthy of being followed in other towns so situated as to be enabled to take advantage of it.

This town is within easy shipping distance of the Hocking and Jackson county coal districts, and its manufacturing interests being quite large, a great deal of coal is consumed there. Other towns around them have discovered natural gas, and thus solved the cheap fuel problem, while the manufacturers of this town, after sinking a number of wells, have apparently given up all hopes of obtaining natural gas, and have now done what seems to us to be the next best thing, if, indeed, it does not prove in the end to be better than gas, which is by no means impossible.

They have organized a coal company of their own, and have acquired possession of two coal mines capable of supplying them with all the coal needed for their manufacturing, and some to spare to private consumers. The Mayor of the city (himself a large manufacturer) heads the list of incorporators, which includes the names of other prominent manufacturers. A local paper says: "The company is organized for the purpose of furnishing coal to the manufacturers of the city and to private consumers, independent of all trusts and combinations, and to operate their mines so as to avoid strikes and all labor troubles if possible."

We venture to predict that it will be found possible to avoid labor troubles, and that, as the same paper remarks: "This is one step toward the solution of the cheap fuel problem."

Not only have manufacturers generally to pay exorbitant prices for their coal, but strikes (frequently brought about by the mine owners for the purpose of giving them a pretext for raising prices) cause a scarcity of coal and consequent shutting down of manufacturing establishments, resulting in serious loss to their owners, and the workmen employed in them, and to business generally.

We think these manufacturers have taken an excellent, if not the best possible plan to insure themselves against loss from this cause, as well as to secure fuel at something like fair prices; in short, to make themselves independent of the rapacity of mine owners.

Then the coal mines are known to be practically inexhaustible, while gas wells are by no means known to be inexhaustible; but, on the contrary, there are some good reasons for believing that the supply of natural gas is comparatively limited, and may before long be seriously diminished; in which case those towns, the manufacturers of which have secured for themselves a supply of coal, at the cost of its production and transportation, would be in the best position, for manufacturing, and would have a decided advantage over those compelled to pay any price demanded by any possible combination of mine owners.

The Difference.

Some recent events bring forcibly to mind the difference between the form of the American government and that of other countries, and its bearing upon the welfare of the people, their manufacturing and other interests.

We are just now beginning the process which is to result in the choice of the man who is to be our chief executive for another four years, and it will be noticed that the most prominent consideration governing that choice is now, and will be during the campaign, the welfare of our manufacturing interests, and of the men employed in them. The man and the policy believed by a constitutional majority of our citizens to be the best man and the best policy for our industrial interests will be placed in power, and it will be the duty of the minority to submit to that decision. No one who has the faith in the intelligence and patriotism of his countrymen that we all ought to have, can fail to believe that that decision will be right, or that, if a mistake is made, it will be quickly remedied. The will of the people is to be expressed, at any rate.

How different the case with Germany. Her ruler has been changed twice quite recently, in the only way rulers are changed in that country, and the people had no voice in the matter at all. No need to discuss the views held by the new emperor upon tariff or upon any other question affecting the business and manufacturing interests of the country; for, no matter if such discussion should prove that nine-tenths of the people believed that he represented all that was opposed to their best interests, he would be crowned, unless prevented by revolution and bloodshed.

He may prove to be a wise and good ruler, or he may prove to be the opposite; and if the latter, there is no practicable remedy; he will have to be endured.

These events, happening at this time, are not without their lessons, which should be of value to us. Our politics are by no means all that we could desire, and yet, the people have always their constitutional remedy for any evils inflicted by government, and we refuse to believe, as the politicians would have us, that we are in a very bad way, and that there is great danger that a majority of the people will vote to send the country to the dogs. At any rate, their will is to be done, and the character and policy of their ruler is not to be a mere matter of blind chance.

What to Invent.

A correspondent writes and asks us to "give a list of the engineering inventions most needed." We can't do it; we don't believe any one can. It has been said that one of the most important and difficult things in connection with invention is to determine just what is needed.

A great deal of time and money have been spent in inventing things which were not needed at all.

A few days ago we were in a large electrotyping establishment, watching the operation called "backing" electrotypes, which consists of depositing "electrotype metal" upon the back of the thin copper, which has been taken from the wax matrix, upon which it had been deposited by battery.

To do this, the thin sheets of copper were placed face downwards, upon a smooth, heated iron surface, called a "backing-pan." Tinfoil is put upon them (which melts), and then, with a ladle, melted electrotype metal is poured over them, and adheres to the copper, giving the plate the required thickness, either to be fastened to wood, to make the electrotype "type high," or, in some cases, enough is poured on to make them "type high" without the wood.

One of the proprietors, who was with us, said that it was well known that the copper had less specific gravity than the electrotype metal, and would therefore float upon its surface, and it was accordingly considered necessary to have something to hold the plates down close to the iron surface, and prevent the electrotype metal from getting beneath them; which, of course, would fill up the lines upon the faces, and spoil them.

Numerous devices were invented and patented for this purpose, and were regularly used, until one day a careless workman, unmindful of the numerous admonitions he had received to be very careful and see that the plates were properly held down, forgot to apply the device for that purpose, and poured on the metal. Then the discovery was made that the inventions for holding down were entirely useless; that the plates would stay down without them; and since then they have been simply allowed to stay down, without anything to hold them—an illustration of the fact that the first and most important thing to do in inventing is to find out what to invent. It is for this reason that men who are engaged in any given industry are most apt to be successful with inventions relating to that industry.

A Wonderful Pump.

It is astonishing, in times of very general dissemination of mechanical knowledge, how honest people will continue to fool themselves and others into the belief that they can circumvent Nature, and so contrive to get something for nothing. The details of the latest instance that has come to our notice in which this is attempted are furnished us by a correspondent, who speaks of it as an example of the credulity of those who ought to know better. It is a pump, and he says that a superintendent of water-works and a learned judge are, apparently, honestly interested in the scheme. Our correspondent sends us a blue print of the pump, and describes the claims made for it. From this print and description the pump cylinder appears to be divided in the center, and there is a piston arranged to work in each end of the cylinder. Then, by the aid of a peculiar arrangement of valves, and a vivid imagination, the pressure on the pistons is balanced, and the pump goes right along delivering water, saving seventy-five per cent. of the power.

Of course, beginning at the right place, and reflecting that to lift a pound of water, or anything else, a given number of feet high, will, leaving friction out of the question, require the doing of a corresponding number of foot pounds of work; will prevent getting misled by any such specious reasoning; but there are, in these days of mechanical enlightenment, a good many men who will not begin at the right place. Our correspondent concludes:

"I send you this, as it is a fair sample of the many simple things that mechanics, or men who call themselves such, get stuck on. It has already created considerable excitement."

Perhaps, after all, such things are for the good of the trade. Who shall say?

Literary Notes.

TRANSACTIONS OF THE AMERICAN INSTITUTE OF MINING ENGINEERS. Contents and Index. Vols. I to XV, inclusive. Published by the Institute. R. W. Raymond, Secretary, 13 Burling Slip, New York.

This volume is an index to the proceedings of the society. It gives the table of contents of the published transactions of the Institute from 1871 to 1887, inclusive. It will be found a very convenient work for those who have access to the literature of the Institute.

We have received one of *The Higgins' Bevel Gear Charts*, published by Eugene Higgins, Battle Creek, Mich. The object of these charts is to do away with the labor of computing the various angles and diameter increments of bevel gears, by finding the proper dimensions by inspection. There is a table giving the "center angle" or angle of the pitch cones for the large and small gears of pairs having various proportions to each other, from 1 to 1 (miter gears), up to pairs having a proportion of 10 to 1. There are two charts laid off in numbered horizontal, vertical and diagonal lines, one for determining the angle increment and cutting angle, and the other for the diameter increment, or amount added to the pitch diameter to make the total diameter of the blank. There is also a sectional drawing of a pair of wheels upon which is plainly indicated the meaning of the various terms used. This, with the printed explanations and directions, makes the matter very simple, and we should think no one would find any trouble in understanding and using the charts. Angle increments are determined to tenths of degrees, and diameter increments to the nearest hundreth of an inch. They are printed upon a single sheet of heavy paper adapted to withstand the necessary usage of the drafting room, and are sold at $1 by the publisher as above.

Railway construction, which it was claimed would show a large falling off this year, does not so far justify the conclusions reached. At this time it looks as though as much new track would be laid this year as in any previous year, with perhaps one exception.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(314) B. B. J., Marion, Ohio, asks: Which is the best metal to put in fusible plugs for boilers? *A.*—Banca tin is generally considered to be the best.

(315) C. W., New York, writes: I would like to build a small steamboat about 18 feet long, 44 inch beam, depth 18 inches. I have a small engine with cylinder 2½ inches diameter, 3 inch stroke, making about 350 revolutions per minute. I would like the speed of boat to be about 6 miles per hour. Do you think the engine is large enough for the purpose? Also will a boiler 24 inches high, 16 inches diameter, fire-box 12 x 12 inches, with 30 flues, 1 inch diameter, 12 inches long, furnish steam enough at a pressure of 150 pounds? *A.*—If your boat has sharp lines correctly designed, the engine will be large enough. If the boat has full lines, you will not obtain the speed desired. The boiler is too small for either a sharp or full boat; for the latter you will require a boiler, with about 45 square feet of heating surface, and about 2 square feet of grate surface. Do not make the flues less than 1½ inch diameter; 2 inches diameter will be better.

(316) M. J., ———, asks: 1. Does round or octagon steel make the best punches and dies? If round, why? If octagon, why? *A.*—The quality of steel is entirely independent of the shape of the bar. Good steel may be rolled into bars of any desired shape, and is as good in one shape as in the other. Cold chisels are usually made of octagon steel, and probably some steel makers put steel of a suitable temper for chisels into octagon bars only. Then the fact that their octagon steel is of a temper most suited to cold chisels might make it better for some certain other tools besides chisels, and inferior for still others. Steel makers prefer to know what steel is to be used for, so that they may furnish steel adapted to the purpose, but they will then furnish it in any desired shape. 2. Does a fine refinement in steel (after hardening) always indicate a good cutting edge? *A.*—No, not exactly. It simply indicates usually, that the steel has been hardened at the proper temperature to put it in its best condition. With some brands of steel and for some purposes this may be just right without tempering; but usually the temper must be drawn, and, supposing the forging and hardening to have been done properly, the quality of the cutting edge will depend upon the skill used in drawing.

(317) T. E., Delano, Pa., writes: An ordinary 10 wheeled freight engine was run on to the scales to ascertain the weight of engine. The drivers and truck wheels were clear on the scales and the tank was off. The tank wheels were blocked and the brake on tight. Reverse lever all the way ahead, with full pressure of steam in the boiler. The engine was weighed the second time under precisely the same circumstances, and registered 1,400 pounds more than she did in the first place. The pulling bar between engine and tank was horizontal, and without bind, and the rubbing casting did not touch. Is this a common occurrance? Give me any information on the subject you can. *A.*—If you are certain that the engine had the same amount of water and fuel, in both instances, and that the same rails and blocks on the scales were used, then we should say that scales were out of order. Or again it might be possible that the engine had a leaky throttle, and was pulling when on the scales, more or less, with the reverse lever set ahead as you have stated. In that case, considerable difference in the weight of engine could be registered, and the pulley bar appear to have no bind in a vertical direction.

(318) J. L., Vallejo, Cal., writes: Please give me a rule for finding the safe pressure in pounds for a boiler, which will enable me to calculate the thickness of steel or iron for boilers of any size. *A.*—The rule prescribed by the Board of Supervising Inspectors for finding the safe pressure on a boiler is as follows: Multiply one-sixth of the lowest tensile strength found stamped on any plate in the cylindrical shell by the thickness expressed in inches or parts of an inch—of the thinnest plate in the same cylindrical shell, and divide by the radius or half diameter—also expressed in inches—and the quotient will be the pressure allowable per square inch of surface for single riveting, to which add twenty per centum for double riveting. This rule can be expressed by symbols, which enable us to read it quicker. Thus: Let P stand for the steam pressure in the boiler, r for radius in inches, and s for tensile strength found stamped on the sheet, and t for the thickness in inches. Then we have for a cylindrical boiler whose longitudinal seams are single-riveted:

$$P = \frac{\text{1-6 } s \times t}{r};$$

and the thickness will be

$$t = \frac{P\,r}{\text{1-6 } s}$$

For cylindrical boilers whose longitudinal seams are double-riveted, we have

$$t = \frac{(P - .16\ P) \times r}{\text{1-6 } s}$$

(319) Subscriber, Illinois, writes: A short time ago an Eames vacuum brake was put on a pony engine in the shop where I work. A great deal of argument arose, as to whether, after the brake has been applied (that is, after the vacuum has been created, and the diaphragm has drawn the brake up) there is any strain on the bracket to which the diaphragm is attached. Some claim that the strain, if any, is in the direction of the pull of the diaphragm, while others say it is the reverse; and again some think there is no strain on the bracket. Please inform me of the direction of the strain, if there is any, also how much, and the reason of the same. *A.*—Creating a vacuum on one side of the diaphragm simply tends to lessen the distance between the center of diaphragm and the center of the kettle-shaped iron casting to which the former is attached. If now, for instance, one man takes hold of the bottom of the kettle-shaped casting, and another man takes hold of the eye bolt in the diaphragm, and then the air is exhausted between the two, it must be evident that, in order to prevent the casting and the diaphragm from approaching each other, one man must pull just as much as the other. Precisely the same effect is produced in exhausting the air when the casting is fastened to a bracket; that is to say, there will be just as much pull on the bracket to which the kettle-shaped casting is bolted as there will be on the rod which is attached to the eye-bolt in the diaphragm; and the stress will be in the direction of the latter. As to the amount of stress; that will depend on the ratio of the lengths, and the arrangements of the levers placed between the diaphragm and the brake shoes, and may vary in the different classes of engines. 2. I would also like some information on case-hardening. Would you give some practical experience on case-hardening. *A.*—See AMERICAN MACHINIST, Jan. 19, page 4; Aug. 16, page 4; Aug. 23, page 8; Sept. 13, page 8; all in the year 1884. Also see answers to Questions 155, 207, 280, 429, all in 1886; and 62, 372 in 1887; and an article by B. F. Spalding in our issue of June 23, 1888.

(320) W. C. O., Riverdale, N. Y., asks: What are the additional qualifications recently required of candidates for a marine engineer's license. *A.*—No person shall receive an original license as engineer, or assistant engineer, except for special license on small pleasure steamers of 10 tons and under, and ferryboats navigated outside of ports of entry and delivery, who has not served at least three years in the engineers' department of a steam vessel. Provided, that any person who has served for a period of three years as a locomotive or a stationary engineer, or as a regular machinist in a steam engine works at least three years, may be licensed to serve as engineer on steam vessels, after having had not less than one year's experience in the engine department of a steam vessel of twenty tons or upward, which experience must have been obtained within two years preceding the application (which fact must be verified by the certificate in writing, of the licensed engineer or master under whom the applicant has served, said certificate to be filed with the application of the candidate); and no person shall receive license as above, except for special license, who is not able to determine the weight necessary to be placed on the lever of a safety valve (the diameter of the valve, length of lever and fulcrum being known), to withstand any given pressure of steam in a boiler, or who is not able to figure and determine the strain brought on the braces of a boiler with a given pressure of steam, the position and distance apart of braces being known; such knowledge to be determined by an examination in writing, and the report of examination filed, with the application, in the office of the local inspectors, and no engineer, or assistant engineer, now holding a license, shall have the grade of the same raised without possessing the above qualifications. And no original license shall be granted any engineer, or assistant engineer, who cannot read and write, and does not understand the plain rules of arithmetic. 2. In the construction of water tube boilers for marine use, what cast metals will be allowed? *A.*—For elbows and similar connections exposed to the fire or heat from the same, wrought-iron, steel, brass or copper are allowed; cast-iron for the same purposes is not allowed.

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See Grant's Gear advt. on back page.

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"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the inuicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, the full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.

The series of articles by J. G. A. Meyer, on "Practical Drawing," now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October 23, 1886 issue, and up to and including June 30, 1888 issue, 53 articles have been so far published. Copies containing these articles, sent by mail to any part of this country or Canada, at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

"Modern Locomotive Construction," by J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 68 articles have thus far appeared up to and including the July 7, 1888 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

MANUFACTURES

The Fall River, (Mass.) Moulding and Decorative Company, has been organized, to manufacture moulding machines.

The Southern Pacific will erect machine shops at Fresno, Cal., making that the end of the division, instead of Tulare.

Mr. Jarvis B. Edson, of 145 Broadway and 86 Liberty street, has just issued a neatly printed catalogue of his pressure-recording gauge.

The Boston & Albany Railroad have successfully applied the Mason pump pressure regulator to the Westinghouse air brake pump, in order to keep an even pressure in the reservoir.

The furor in favor of gas wells is set forth by the following dispatch from Upper Sandusky, Ohio: Our city council has decided to drill another well and has awarded the contract to a man named Frederick.

The Virginia Car Equipment, Trust and Motive Power Company, of Portsmouth, Pa., has been incorporated for the purpose of manufacturing cars, locomotives, etc. Thomas Breen, of Knowlton, Pa., is president of the company.

A dispatch from Farmington, W. T., states that work has begun on the road to Spokane Falls and the Cœur d'Alene mines. Thirty-three miles will be completed to Rockford at once. Bids will be in shortly for the Cœur D'Alene branch.

The Waterhouse Electric and Manufacturing Company, Hartford, Conn., have recently made shipment of two car loads of machinery to the Cincinnati exposition buildings. This company has the contract for lighting the building and grounds.

The Volker & Felthousen Manufacturing Company, Buffalo, N. Y., is running its shops until 9.30 P. M. They are working on water-works plants at Jamestown, N. Y.; Albion, N. Y.; Booth Bay, Me.; Pierce City, Mo.; Phœnix, N. Y.; Holdredge, Neb.; Pine Bluff, Kan., and Owensboro, Ky.

There is agitation for water-works at Sutton, Neb.; Montrose, Col.; Albany, N. Y.; Somerville, Mass.; Orange, Tex.; Oberlin Kan.; Malone, N. Y.; Sandersville, Ga.; Hamilton, Maine; Vinton, Iowa; McKeesport, Pa.; Berea, Ohio; Trenton, N. J.; Brooklyn, Ohio; Brantford, Ky.

The Indianapolis, Ind., Veneering Works, owned by George F. Adams and M. D. Williamson, were totally destroyed by fire recently, together with the fancy cabinet factory connected therewith, owned by D. E. Stone & Co., and the hard work and ripping factory belonging to M. J. Osgood & Co.

Senator Chandler has introduced in Congress, by request, a bill appropriating $150,000 for the development and encouragement of silk culture in the United States. It creates a division of silk culture in the department of agriculture, and authorizes the establishment of experimental silk culture stations throughout the country. It provides for the free distribution to the farmers and others, of mulberry seed and silkworm eggs.

The Vestibule trains for the Michigan Central, which has been in process of construction at the car works at Grand Rapids for the past spring, are now complete and go into service Friday on the limited express. They will be drawn by a fast 100-ton mogul engine. The entire train, baggage car, smoker, day coach, dinner and sleeper, is built on the vestibule system, having the platforms enclosed so as to make a complete covered way between cars.

New water-works, or the enlargement of existing works are contemplated at Burlington, Vt.; Addison, N. Y.; Otsego, N, Y.; Etna, Pa.; Culbertson, Neb.; Chadron, Neb.; Cantro Point, Iowa; Mulford, Ore.; Pinckneyville, Ill; La Grange, Ga.; Nicholasville, Ky.; Northfield, Vt.; Centreville, Md.; Scottsdale, Pa.; Springfield, Ohio; Franklin, Pa.; Cincinnati, Ohio.; Burlington, Vt.; Tarentum, Pa. Brooklyn, N. Y.; Lynchburg, Va.; Colorado Springs, Col.; Chadron, Neb.; Dover, N. H.

The Graphic Process Company has purchased a tract of land at Pleasantville, N J., upon which to erect larger factories to build their improved composing and type-writing machines. Two brick buildings will be erected at once—one 60 x 200 feet will be used as a machine shop—the other 25 x 50 feet will be used as an engine, boiler and blacksmith shop. They will require a 45 horse-power engine and a 60 horse-power boiler. An electric light plant of about 150 incandescent and 20 arc lamps will be put in. The building will be heated by steam. A full line of general machine tools and drawing room fittings will be required. Their present shop will be fitted up for use as offices and drawing rooms.

Fleming & Kimball have located and are doing business at 17 Dey street, New York. This firm are the managers of the foundry and machine department of the Harrisburg Car Manufacturing Company, which build the Ide automatic engine, as well as portable and other engines, boilers, steam road rollers, etc. They have put in at the New York office a large stock of asbestos packed valves and cocks, inspirators, and will make a specialty of a full line of mill and steam supplies. Mr. Fleming is from Harrisburg, Pa., and Mr. Kimball is from Hartford, Conn.; both are practical men, well acquainted with the business in which they are engaged.

The board of public affairs of Cincinnati, Ohio, has authorized the construction of an electric street road over what is known as route No. 7. The subject was considered in committee of the whole. Only two Alderman, Messrs. Cherry and Anthony, were present. Each clause was read and discussed separately. There was very little difference of opinion. Dr. Graydon wanted the company to be required to transfer passengers from the Baymiller Line to the electric road at Sixth and Elm. The board will probably recommend the ordinance as recommended by Council for passage. The road is to run from Columbia to McMicken avenue, at five cents fare for the entire distance. The board will take up the ordinance next week. The only changes made in the ordinance were the elimination of clauses recognizing the rights and franchises of the dummy road in Columbia.

Machinists' Supplies and Iron.

NEW YORK, June 21, 1888.

Iron—American Pig—We quote Standard Lehigh brands, $18 to $18.50 for No. 1 X Foundry; $17 to $17 50 for No. 2, and $15.75 to $16.25 for Grey Forge. Outside brands are cheaper, but difficult to quote.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Wanted—Men to examine S. S. planes; see p 11.

Position wanted by mechanical draftsman; American and a shop graduate. Box 105, AM. MACHINIST.

Wanted—Competent machinists on lathes and planers. The Pond Machine Tool Co., Grant ave., Plainfield, N. J.

A first-class draftsman and designer, with eight years' experience, is open for engagement. Address Box 103, AM. MACHINIST.

Wanted—An experienced mechanical draftsman. Address, stating particulars as to age, experience and compensation, A. L. T., AM. MACHINIST.

Wanted—A good machinist; a young man of good character preferred; permanent place for the right man. Call on or address Lane's Machine Works, Huntingdon, Pa.

A young man, at present in charge of the drawing room of a large establishment manfg. Corliss Engines and general machinery, desires to make change. Box 106, AM. MACHINIST.

An experienced draftsman wishes a position in Wis., Ill., or Iowa, with the chance to work into a business. A No. 1 references. Correspondence solicited. A. L., AM. MACHINIST.

Wanted—A smart, ingenious mechanic, who understands working small tools, drills, millers, etc.; salary $2 50 per day; young man preferred. Address "A," Letter Carrier 31, Buffalo, N. Y.

Wanted—A first-class draftsman, experienced in machine tools for machine shop and railroad use; none but competent, first-class men need apply; state experience, age, and wages required, to Box 101, AM. MACHINIST.

Wanted—Position by experienced designer and draftsman, with extensive and varied practice in steam engine, locomotive and mining work. Colorado or other Western State preferred. Address John Ives, Box S. Trinidad, Col.

✢ MISCELLANEOUS WANTS. ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Gerlach's Engineers' specialties beat the world. Send for price list. Crescent Mfg. Co., Cleveland, O.

Crescent grease cup for shafting beats them all Sample free. Crescent Mfg. Co., Cleveland, Ohio.

D. J. Kelsey, M. E., 31 Ins. Bld., New Haven, Ct. Machine designing, also Patent Office drawings.

Wanted - Parties having machinery specialties to build, to correspond with. Box 75, AM. MACHINIST.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Correspondence solicited with parties having machine or foundry specialties to build. Honesdale Iron Works, Honesdale, Pa.

Wanted—Parties having specialties to manufacture, correspond with Cedar Point Foundry and Machine Shop, Port Henry, Essex Co., N. Y.

August C. Christensen, M. Am. S. M. E., 24 State st. (Battery), N. Y.; 463 Henry st., Brooklyn. Working drawings and superintending the building of machinery; steam, pumping and gas engines indicated.

For Sale—My patent flue cleaner, or would like to get it manufactured on royalty: see cut in this paper, June 9, 1888. For further information address E. D. Weston, Jackson, Mich.

For Sale—In Birmingham, Ala., machine shop, equipped with best make of new machinery; a bargain for most any manufacturer with moderate capital. Opportunity, AM. MACHINIST.

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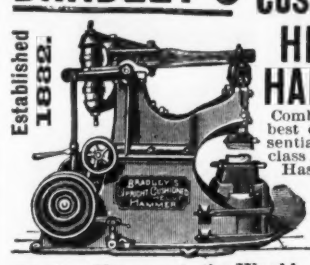

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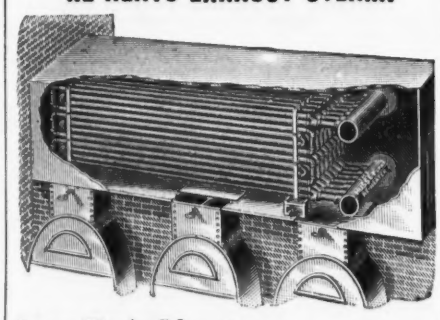

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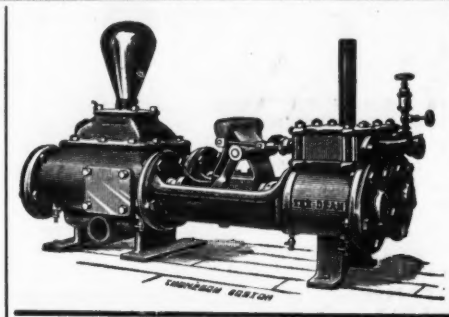

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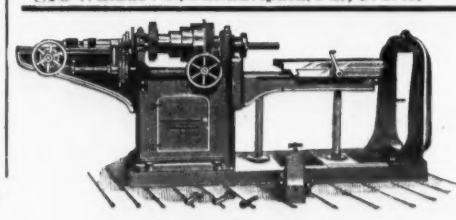

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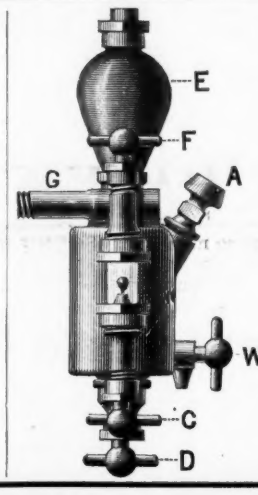

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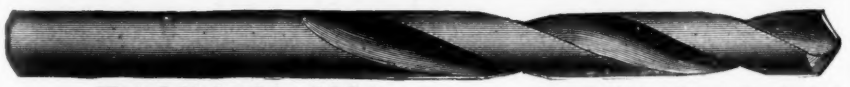

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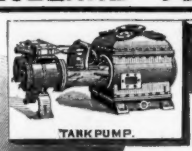

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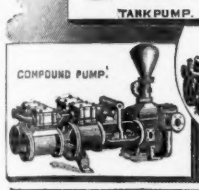

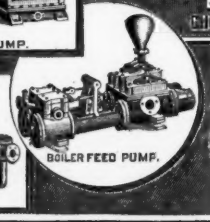

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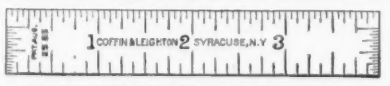

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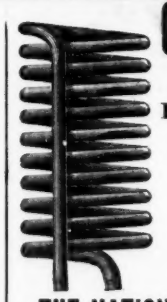

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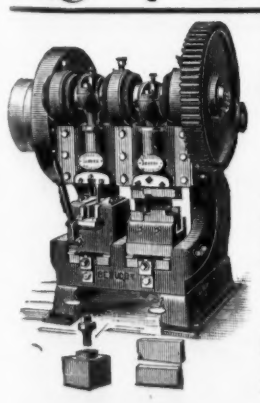

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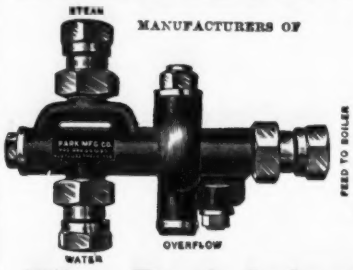

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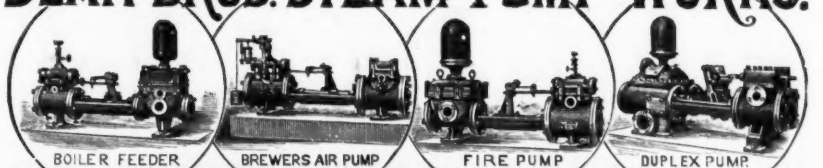

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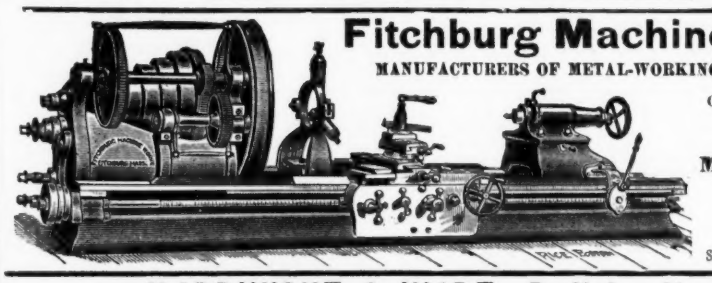

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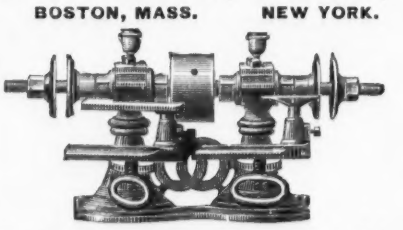

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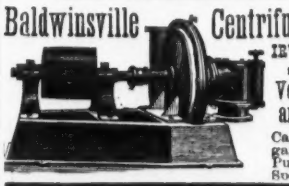

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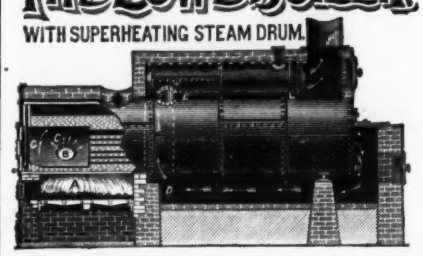

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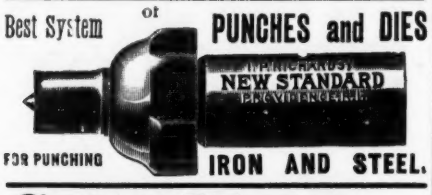

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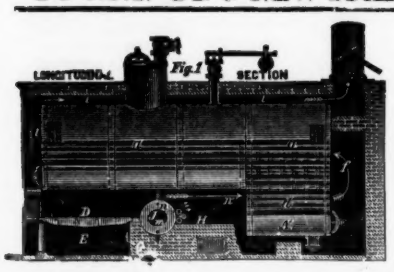

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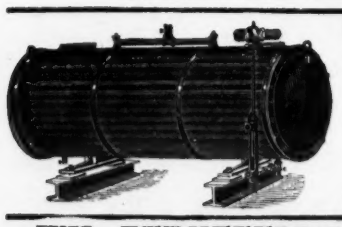

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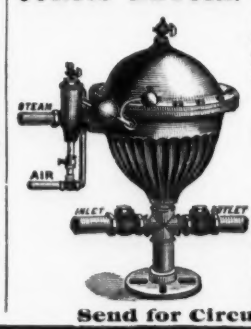

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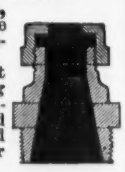

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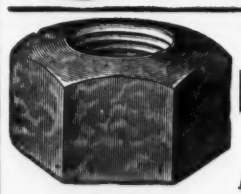

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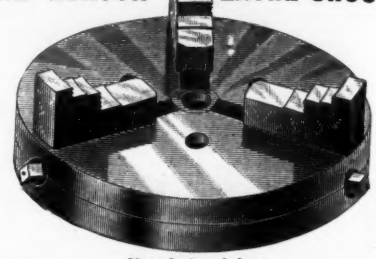

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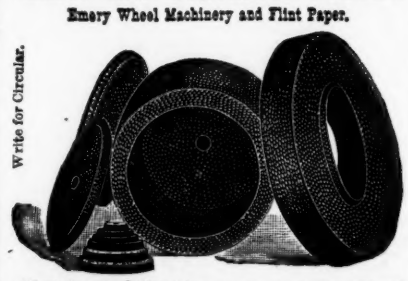

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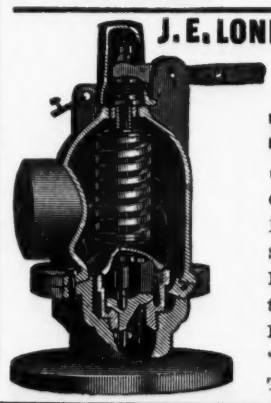

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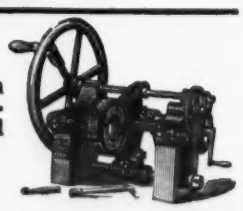

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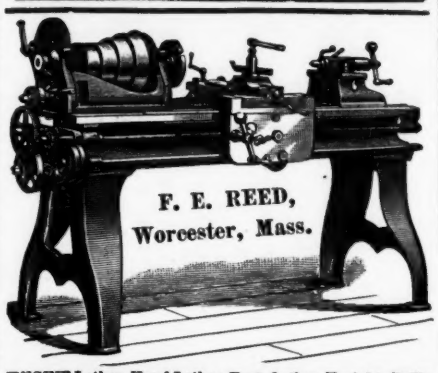

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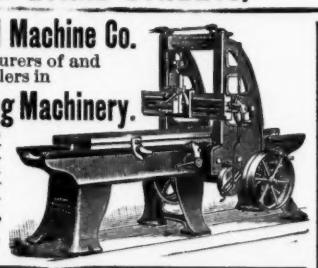

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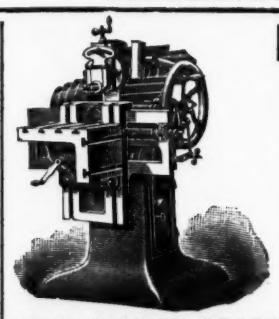

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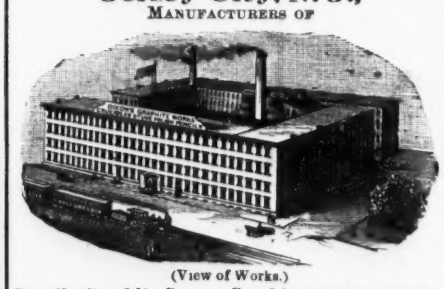

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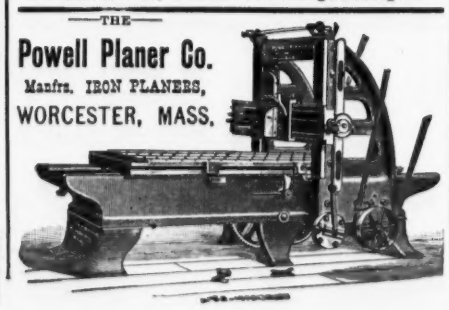

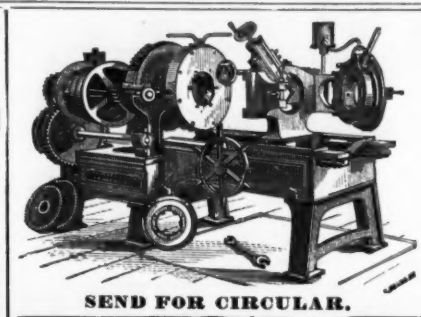

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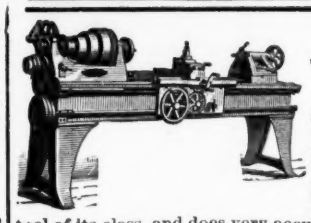

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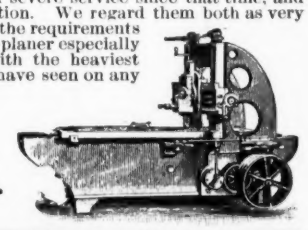

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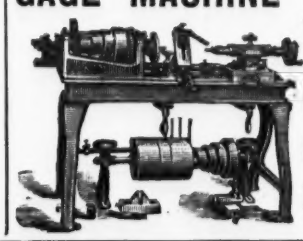

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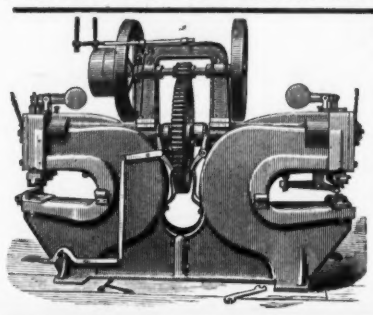

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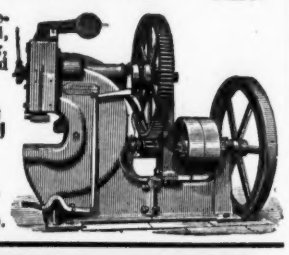

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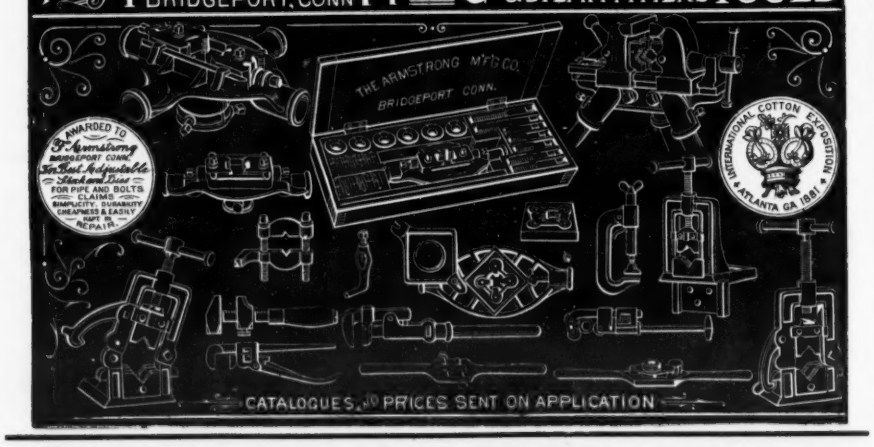

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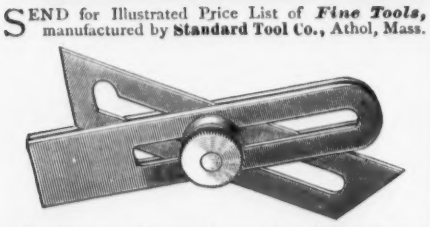

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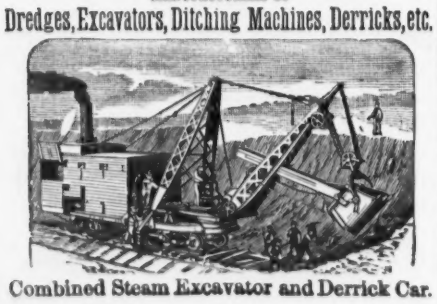

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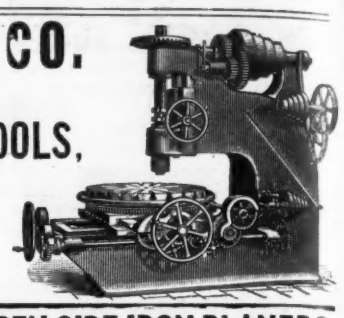

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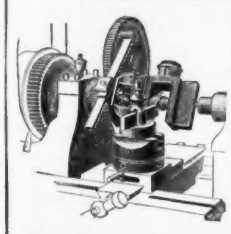

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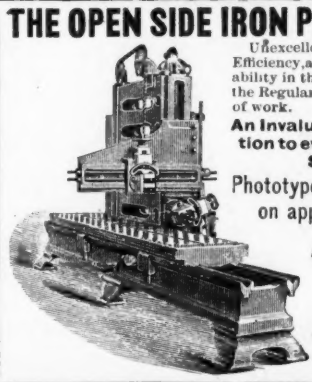

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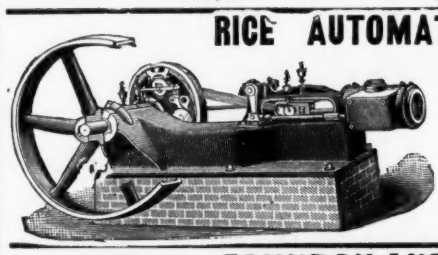

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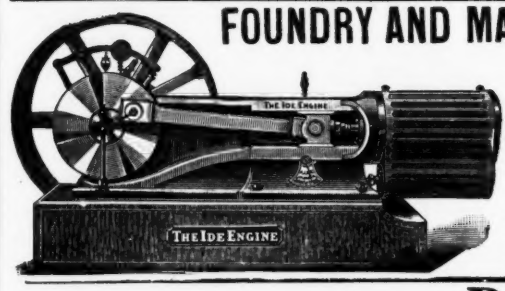

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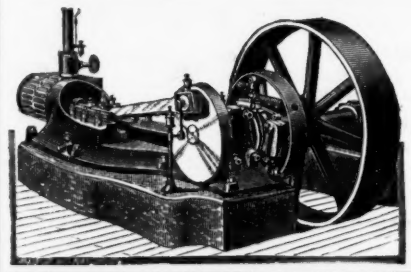

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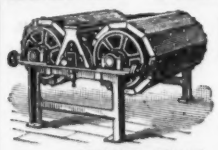

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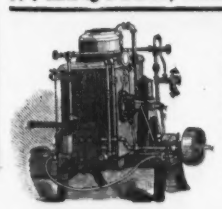

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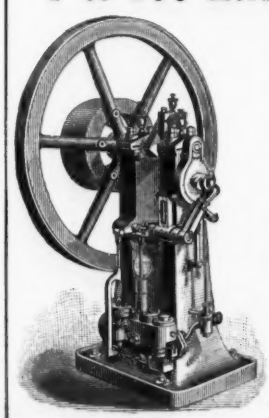

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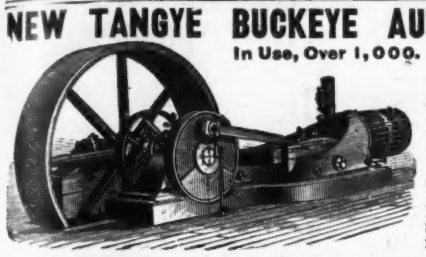

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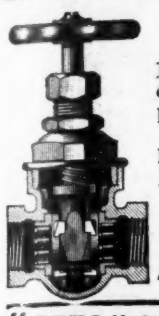

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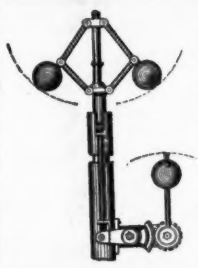

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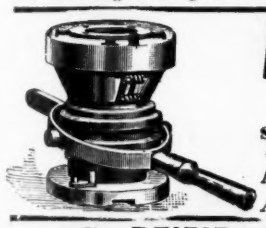

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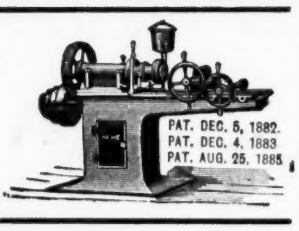

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26 in. x 7 ft.	"	Brettel,	"
27 in. x 4 ft.	"	Windsor,	cheap.
30 in. x 8 ft.	"	each Atherton, Powell & H. & P.	new.
36 in. x 12 ft.	"	Niles,	good.
38 in. x 14 ft.	"	Enterprise,	cheap.
60 in. x 12 ft.	"	G. W. & W. Screw,	good.
54 in. x 12 ft.	"	Bement,	fair.
11 in. x 5 ft.	Engine Lathe,	Prentice,	new.
12 in. x 6 ft.	"	Young,	"
13 in. x 6 ft.	"	Ames,	"
14 in. x 6 ft.	"	Blaisdell,	"
14 in. x 7 ft.	"	Bogart,	"
14 in. x 6 ft.	" Gap Bed,	S. M. & Co.,	"
15 in. x 6 and 8 ft.	"	Porter,	"
16 in. x 6 ft.	"	Ames,	A 1.
16 in. x 6 and 8 ft.	"	Blaisdell	new.
16-20 in. x 6-8-10 & 12 ft.		Bridgeport,	"
18 in. x 8-10-12 ft.	"	Different Makes,	"
20 in. x 8-10-14 ft.	"	Different Makes,	"
20 in. any length Bed	"	Bridgeport,	"
22 in. x 12 ft.	"	Niles,	heavy.
23 in. x 8-10 12 & 14 1 2	"	Br dgeport,	new.
25 in. x 12 ft.	"	Wright,	new.
28 in. x 6 ft.	"	Fifield,	"
36 in. x 14 ft.	"	Fifield,	"
2 in. Drill		Davis.	"
20-24 25-28 inch Drills		Blaisdell,	"
24-25-28-32 inch	"	C. & S.	"
5 ft. Am. Universal Radial Drill,			"
No. 1 and 3 Universal Miller,		Brown & Sharpe,	"
No. 1-2 and 6 Plain	"	" "	"
No. 1 Universal Grinder,		" "	"

Cold Rolled Shafting in Stock. Send for list. Write for what is wanted.

E. P. BULLARD,

62 College Place & 72 Warren St., New York.

IMPORTANT!

We are now placing on the market 17", 24", and 27" Engine Lathes, same design and construction as our celebrated 19" and 21" Lathes.

We shall produce them in large lots, in order that we may be able to offer them at the popular prices that induced the unprecedented sale of our 19" and 21" Lathes.

Weight of 24" with 10 ft. bed, 5200 lbs.

Weight of 27" with 10 ft. bed, 6500 lbs.

We furnish, without extra charge, *Taper Attachment, Compound Rest, Automatic Stop for Carriage, Pulley Rest, Etc.*, in addition to regular attachments.

WRITE FOR PRICES, WITH CUTS AND DESCRIPTIONS.

LODGE, DAVIS & CO.

MANUFACTURERS

Machine Tools,

159, 161, 163 and 165 EGGLESTON AVE.,

136, 138, 146, 148, 150, 152, 154 E. 6th St.

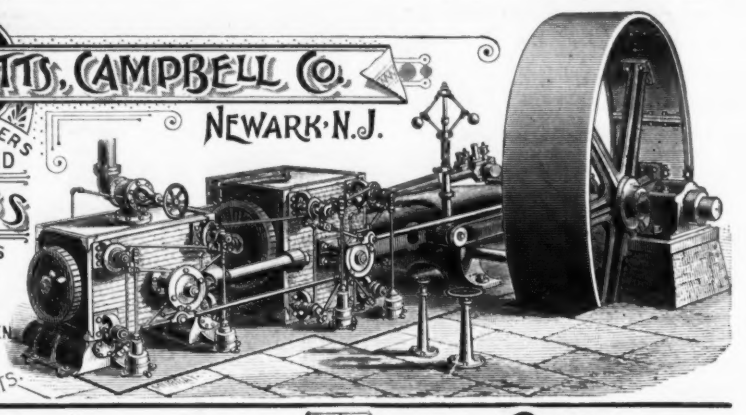
CINCINNATI, OHIO.

(See our advertisement on last page.)

THE WATTS, CAMPBELL CO.

MANUFACTURERS OF IMPROVED CORLISS STEAM ENGINES IN FULL VARIETY.

NEWARK, N.J.



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The HEWES & PHILLIPS IRON WORKS

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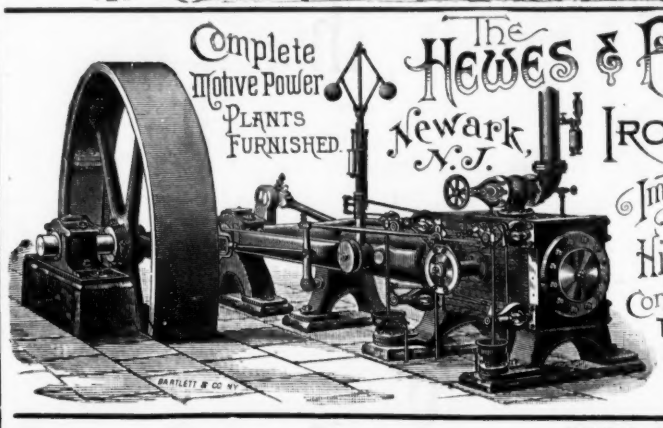
Complete Motive Power Plants Furnished.



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GEO. A. BARNARD, AGENT.

Eclipse Corliss Engine.

FRICK COMPANY, Builders,

WAYNESBORO, PA.

Non-Condensing, Condensing, Compound.

40 TO 1,000 H.P.

Send for Circulars.

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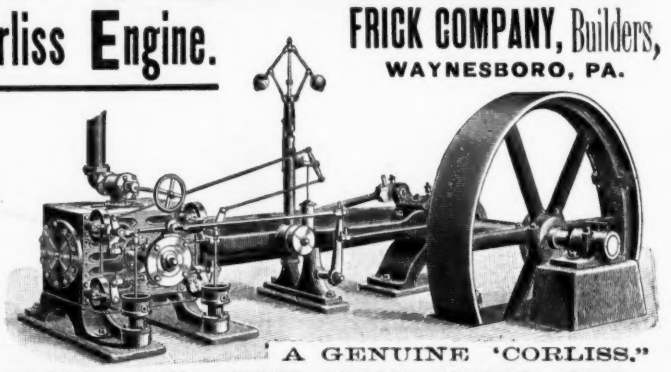

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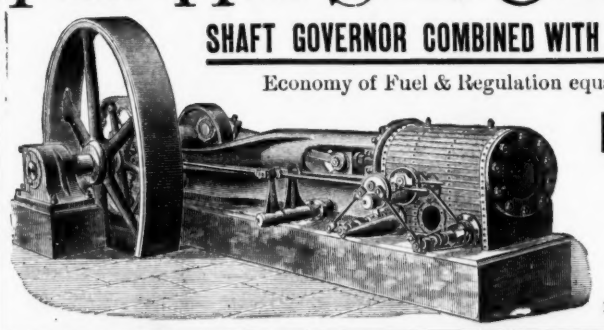
M. J. TIERNEY, 20 NORTH CANAL STREET, CHICAGO, WESTERN AGENT.

PAYNE HIGH SPEED CORLISS ENGINE.

SHAFT GOVERNOR COMBINED WITH CORLISS WRIST-PLATE.

Economy of Fuel & Regulation equal to anything in use.



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Hill, Clarke & Co., Boston, Mass.

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JOHN McLAREN,

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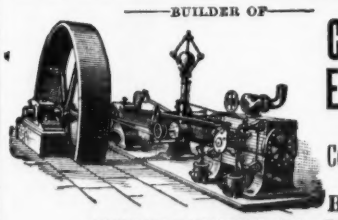

CORLISS Engines, AIR Compressors and BOILERS.

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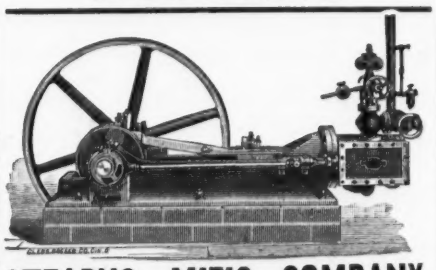

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ENGINES from 15 to 400 Horse Power.

Boilers of Steel and Iron supplied to the trade or the user. Send for Catalogues.

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Works at Erie, Pa.

New York Store, 46 Cortlandt Street,

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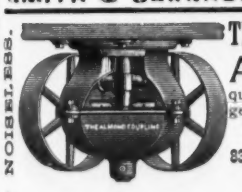

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A NEW quarter turn motion to replace quarter turn belts and bevel gears.

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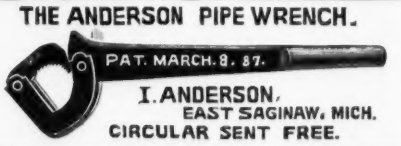

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CIRCULAR SENT FREE.

HILL, CLARKE & CO.

List of Second-Hand Machines, taken in Exchange for New Tools.

24 in.	Swing	22 ft.	Bed	Shafting Lathe,		Providence.
36 "	"	12 "	"	Engine	"	Putnam.
33 "	"	12 "	"	"	"	Portland Co.
18 "	"	9 "	"	"	"	Star.
18 "	"	8 "	"	"	"	Flather.
18 "	"	7 "	"	"	"	D. W. Pond.
17 "	"	5½ "	"	"	"	Shepard.
15 "	"	6 "	"	"	"	Fitchburg.
12 "	"	5 "	"	"	"	Prentice.

Putnam Gap Chucking Lathe, 60 in. swing, 9 ft. bed.
Monitor Brass Lathe, 18 in. swing, 5 ft. bed.
Wheeler Planer, planes 22 in. wide, 4 ft. long.

Providence	"	"	24 "	"	5 "	"
Hendey	"	"	26 "	"	6 "	"
Bement	"	"	30 "	"	8 "	"

Hendey Shaper. 24 in. stroke. Fine condition.
Wiley and Russell Bolt Cutter No 5, cuts ⅜ to 1¼"
Brainard No. 7 Milling Machine with Vise.
Brainard Gear Cutter, 30 in. Automatic Feed.
" " " 18 " " "
Garvin No. 2 Gang Drill, 2 spindles.
" " 4 " 4 "
Pratt & Whitney Vertical Tapping Machines.
2½ in. Cutting-off Machine.

We have a splendid exhibition of New Machine Tools in our New Store. Call and examine.

156 Oliver St., - Boston.

THE UNIVERSAL GRINDING MACHINE,

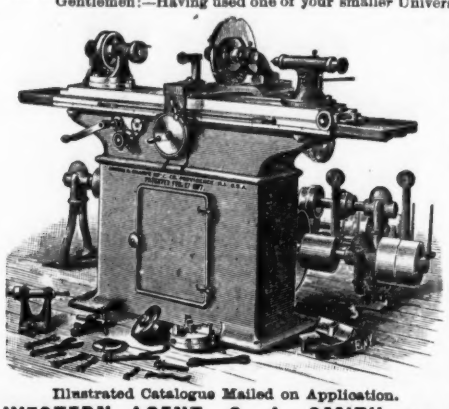
Made by BROWN & SHARPE MFG. CO., Providence, R. I., U. S. A.

TESTIMONIALS.

Wm. B. Bement & Son, Mfrs. of Machine Tools, Steam Hammers, etc.,
Callowhill and 21st Sts., Philadelphia, Feb. 13, 1885.

Brown & Sharpe Mfg. Co., Providence, R. I.

Gentlemen:—Having used one of your smaller Universal Grinding Machines for four years, and another of the larger size for nearly two years, it gives us pleasure to say that they produce economically and well all the kinds of work for which they are intended, and we could not dispense with them. Yours truly,
Wm. B. Bement & Son.



Illustrated Catalogue Mailed on Application.

Wm. Sellers & Co., Philadelphia, Feb. 7, 1885.

Brown & Sharpe Mfg. Co., Providence, R. I.

Gentlemen:—In reply to your inquiry of the 6th inst., we have to say that we have been using your "Universal Grinding Machine" almost constantly since June, 1880, with very satisfactory results. We hope to add more to our plant as business increases. Yours truly,
Wm. Sellers & Co.

Pratt & Whitney Co., Mfrs. of Machinists' Tools,
Hartford, Conn., Feb. 7, 1885.

Brown & Sharpe Mfg. Co.

Gentlemen:—We have had in use since Aug. 1882, one of your Universal Grinding Machines, and since then have bought two more. We find them indispensable in our shop. It has become with us pretty well understood, that there is no way to make a good journal bearing and other cylindrical surfaces, except by grinding. Such a machine must be perfect in its construction to answer the purpose. We find that these machines respond to all the requirements. Very truly yours, The Pratt & Whitney Co.,
F. A. Pratt, Pres't.

We have just published a Treatise on the Construction and Use of Universal Grinding Machines, fully illustrated. Sent by mail on receipt of P.O. money order for $1.33.

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Driving Wheel Lathes For Sale.

Two 60in. Double Wheel Lathes, made by Machine Tool Works, Philadelphia, F. B. Miles, Engineer. These Lathes have been in use a comparatively short time and are in excellent condition. Any Road requiring Lathes for turning truck wheels, steel tired car wheels or small drivers, will find these tools well adapted to the purpose.

Also one 79in. Single Head Driving Wheel Lathe, built by Niles & Co., Cincinnati, Ohio, in excellent condition.

Address:

NILES TOOL WORKS,

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IMITATION

AN ACKNOWLEDGMENT OF SUPERIORITY.

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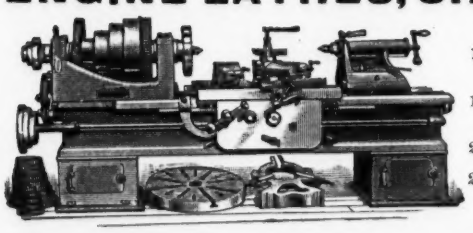
ENGINE LATHES, SHAPERS & DRILLS



15" 20" 26" 32" Shapers.
17" 19" 21" 24" 27" Engine Lathes.
20" 24" Upright Drills.
25" 28" 32" 40" B. G. P. F. Drills.

25-INCH BACK GEARED AND POWER FEED DRILL.

LODGE, DAVIS & CO.,

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Send for Prices. It will pay you.

(See "Important" Notice of Engine Lathes on page 15.)

E. GOULD & EBERHARDT

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Eberhardt's Patent
AUTOMATIC GEAR CUTTER.
18 in. 25 in. 36 in. 50 in.
60 in. 84 in. Sizes.

"Experts pronounced it the best."

GEAR AND RACK CUTTING TO ORDER.

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Small Automatic Miller,
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The Machine shown in cut is designed for rapid and convenient milling of small work.

Send for Catalogue.

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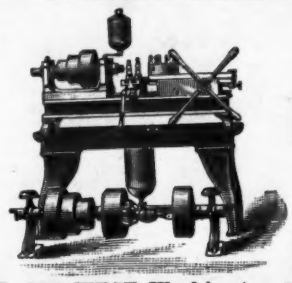
MANUFACTURE
HORIZONTAL Boring Mills,
48 in. and 66 in. Swing.



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For ⅝ in., 3 in. and smaller holes.
Revolving Head Drilling Machines.

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MANUFACTURERS OF BILLINGS' DROP FORGED LATHE DOGS FORGED FROM BEST STEEL FOR THE PURPOSE

IN 12 SIZES ⅜ UP TO AND INCLUDING 4 IN
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DROP FORGINGS OF COPPER, IRON AND STEEL OF ALL DESCRIPTIONS.

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MACHINE TOOLS

For Iron and Brass Work.

SMALL TOOLS & FIXTURES.

Gear Cutting in all its Branches.

ILLUSTRATED CATALOGUE ON APPLICATION.

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FROM 16 to 48 IN. SWING.

Cuts, Photographs and Prices furnished on application.

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Gear Wheels and Gear Cutting.—I make g to order, or cut teeth on g blanks sent to me. Of all kinds. Of all sizes to six ft. dm. Small orders or large ones. Fine g or cheap g. Small cast g. Ready made brass g by mail at low prices. Bevel g with perfect planed teeth. Hand Book on g, $1. Facilities complete. Terms reasonable. Send for cat.
GEO. B. GRANT, 66 Beverly St., Boston, Mass.

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20 in. Drills a Specialty.

Our 20 in. Drill is a heavy substantial tool, made for service, has steel shafts and spindle. Gears and racks cut from the solid, and have all modern improvements, are made by special machinery, and sold very low.

Our Key-Seating Machine will save enough in 60 days' use to pay first cost; no shop can afford to do without one. We have now ready for prompt shipment, both Key-Seat Machines and 20in. Drills. Send for Photo. and Catalogue.

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THE POND MACHINE TOOL COMPANY,

Formerly of Worcester, Mass.

The new shops of this company are located at Plainfield, N. J., forty minutes' ride from New York city on the line of the Central Railroad of N. J., and consist of the following:

A machine shop 500' long by 100' wide; a foundry 250' long by 90' wide; also commodious buildings for the storage of sand, coal, coke and pig iron; ample and convenient wash rooms for the men; fireproof two story pattern storage; blacksmith shop; engine and boiler houses. These buildings are detached from the machine shop and foundry. There is an elevated railroad for the convenient distribution of raw materials, and a railroad running through the machine shop for shipping. The whole plant is supplied with the incandescent system of electric lighting.

The machine shop and foundry have overhead traveling cranes running through their entire lengths; also light traveling cranes, which serve every tool, and a number of jib cranes in the foundry and scratch rooms. The foundry has capacity for making the heaviest class of castings.

All our tools are expressly designed for the economical manufacture of heavy machinery for railroad and general machine shop equipment, from new patterns of the latest and best designs.

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NEW SHOPS, Plainfield, N. J.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.
HARTFORD. CONN.

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Lathes and Planers

FOR ALL PURPOSES.

The G. A. Gray Co.,

477, 479 & 481 Sycamore, cor. Webster. Cincinnati, Ohio.

Photographs and prices sent upon application.

SEE ADVERTISEMENT, PAGE 13.

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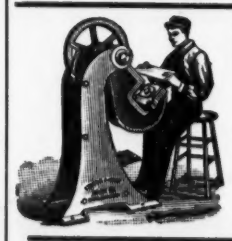
PRATT & LETCHWORTH,
PROPRIETORS
Buffalo Steel Foundry,
BUFFALO, N. Y.



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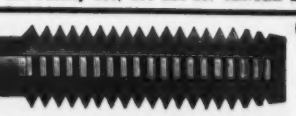

Manufacturer of TAPS & DIES